Approved: 2024-08-08

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NASA TECHNICAL STANDARD **National Aeronautics and Space Administration**	**NASA-STD-8719.9C**
	Approved: 2024-08-08 **Superseding NASA-STD-8719.9B Change 1**

Lifting Standard

DOCUMENT HISTORY LOG

Status	Document Revision	Approval Date	Description
Baseline		2002-05-09	Initial Release
Change	1	2007-10-01	Document revalidation without changes other than updates to Cover, Foreword (address), and Revision Log.
Change	2	2012-09-28	Document revalidation without changes other than updates to Cover, Foreword (address), and Revision Log.
Revision	A	2015-08-13	Added a General LDE Requirements chapter containing requirements common to all LDE. Deleted repetitive requirements from OSHA and NCS throughout the document. Incorporated applicable NCS by reference throughout the document. Added new appendices referencing critical lift requirements and LDEM roles, approvals, and special permissions. Removed appendices that were duplicative of OSHA and NCS.
Revision	B	2018-10-25	Global: replaced “structural sling” with “below-the-hook lifting device”. Global: replaced “NCS” with “VCS”. Global: replaced “National Consensus Standard” with “Voluntary Consensus Standard”. Global: minor punctuation, formatting, and editorial changes. Foreword: removed text regarding changes made in previous revision. 1.3.7 Added “Center/facility” to clarify level of responsible organizations. 2.1 Updated the Applicable Documents General information. 2.1.2 Added document reference “ANSI/ITSDF B56.14-2015 Safety Standard for Vehicle Mounted Forklift Trucks. 3.1 Deleted acronym definition for “SARD” (not used); replaced “NCS” with “VCS”. 3.2 Added definitions for “attachment”, “below-the-hook-lifting device”, “non-load test slings, rigging hardware, and below-the-hook lifting devices”, and “periodic inspection”; modified “critical lift” definition to remove limit of 75% capacity on mobile cranes and clarify; deleted “lifting equipment”, and “wire rope sling” definitions and incorporated in “lifting devices and equipment”; modified “lifting device”, “load”, “periodic load test”, “rigging

			hardware", "sling", "structural sling" and configuration management definitions; modified "nondestructive testing" definition to delete "development and", "replaced "national consensus standard" with "voluntary consensus standard" with the same definition, and deleted the definitions "can", "may, "shall", and "should". 4.2 Clarified responsibilities re: Critical lifts; deleted 75% limit on mobile cranes for critical lifts. 4.3.1 Added requirement for LDEM approval of safety hazard analysis of critical lift/custom LDE, with exclusion. 4.4.2 Added exclusion to requirement for LDEM approval of certain critical lift LDE. 4.5.2 Added note clarifying that periodic load tests are at a lower load than proof tests. 4.5.5 Clarified applicability of notes. 4.7.7 Added note for emphasis re: OSHA requirement (rqmt). 4.7.10 Reinstated rqmt regarding assessing lifts of energetic materials, and reference to 8719.12. 4.9.2, 4.9.3, 4.9.4 Clarified marking requirements in notes. 4.11.2.3 Added reference to NPR 1800.1. 5.7.3 Clarified rqmts for use of OH cranes for load testing other LDE, allowed exceeding 50% of crane rating in certain cases. 5.9.2 Reinstated requirement for OH crane directional labeling. 6.7.2 Added section regarding ascertaining load weight in light of removal of limit on mobile crane critical lifts to 75% of crane rating. 6.7.7 Deleted redundant statement regarding use of operational aids. 7.4.1.1b Reworded for clarity and emphasis. 7.4.2.1, 7.4.2.5, 7.4.2.6 Allowed for use of hoist/winch with single upper limit and no lower limit switch for critical lifts with certain provisions. 7.7.8 Rewritten to allow exceeding 50% capacity when performing periodic load tests of items when items are freely hanging from the hook. 10.1.2 10.5 Clarified that high lift industrial truck attachments (as well as the truck) must comply with standards and manufacturer recommendations, and proof and periodic load test requirements. 10.3 Allowed exception to safety hazard analysis with LDEM approval. 10.5.2.5 Added requirement for load test of forklift attachments.

			10.6.2 Expanded the list of items on a forklift requiring annual inspection. 10.9 Clarified that OSHA and VCS require marking of industrial trucks to identify approved attachments. 13.6.3 Clarified NDT requirements for hooks. 14 Replaced “structural slings” with “below-the-hook lifting devices” throughout. 14.5.2.2 Add to note a sentence regarding who is manufacturer of an assembly with respect to determining testing. 14.5.2.3 Clarified meaning of “permanently attached”. 14.5.2.4 Corrected proof load test requirement for consistency with VCS. 14.5.3.4 Reinstated provision exempting permanently attached hardware from periodic load test. Appendix B updated to reflect changes made elsewhere regarding critical lifts. Appendix C updated to reflect changes made elsewhere regarding LDEM roles, approvals, and special permissions. Appendix D added to provide recommended minimum LDEM qualifications.
Change	1	2022-01-18	Administrative changes associated with the release of NPR 8715.1, NPR 8715.3, and clarifications to Overhead Crane Wire Rope Inspection: 1.4 Request for Relief -1.4.1 Rewrite to address Institutional request for relief process. Adding “Institutional” to Safety, deleting “and Mission Assurance” Added NPR 8715.1 reference, deleted NASA STD 8709.20 reference. Change program to Programmatic. 3.2 Definitions Added * Certified Wire Rope Inspector: Formatted * Physical Wire Rope Inspection (PWRI): Formatted correctly * Visual Wire Rope Inspection (VWRI): Formatted correctly Corrections Grammar- Dummy Load: and Dummy Rated Load: from “typically” to “typically,” 4.1.2 Deleted NPR 8715.3 NASA General Safety Program Requirement; Added NPR 8715.1, Chapter 8: Lifting Devices and Equipment Safety; Deleted Note: Chapter 5 - 5.6.1; New heading, “Overhead Crane Inspection”, no change in content reformatted 5.6.2; New section added, clarification of Wire Rope Inspection.
Revision	C	2024-08-08	• Incorporated Lessons Learned from NASA and Industry mishaps and close calls.

			• Added New Non-Critical Lift Designations in section 4.2. • Reclassification of Safety Hazard Analysis to "Hazard Analysis" in section 4.3 • Added Wire Rope Inspection in Section 4.6.6. • Added lifting explosive and energetic materials in section 4.7.12. • Added New requirement for long term Center shutdown of LDE to prevent unauthorized use in section 4.7.15. • Added Certification Periods Per License Type table summarization in section 4.11.2. • Castellated Beam System inspection requirements added in section 5.4.2. • Added Personnel Training and Licensing in section 6.4. • Updated Hazard analysis for high-lift trucks in section 10.2. • Updated Operations for high- lift trucks in section 10.5 • Removed chapter 11 load positioning devices, and load measuring devices and moved to chapter 13 Slings, rigging hardware, below-the-hook lifting devices, load positioning devices, and load measuring devices" • Updated Chapter 11: Jacks and Chapter 12 Hooks section 12.3. • Added the statement "horizontal jacks, equipment presses, non-portable jacks and leveling devices are not considered NASA lifting devices/equipment and are excluded from the requirements of this NS" in section 11.1. • Removed term equivalent entity in Section 13.3.2. • *Removed Appendix's B, "Summary of Critical Lift Requirement" and Appendix C "LDEM roles, approvals and special permissions to avoid redundancy. • Added new Appendix B "LDE Recommendations for Loaned Equipment and Out-Granting Agreements". • Added Appendix C CBS Memo • Appendix C transferred to NPR 8715.1 as LDEM qualification requirements.

			• Added appendix D Summary of load test and inspection requirements. • Editorial corrections • Format corrections • Updated definition, Acronym, and references.

FOREWORD

This NASA technical standard provides uniform engineering and technical requirements for processes, procedures, practices, and methods that have been endorsed as standard for NASA facilities, programs, and projects, including requirements for selection, application, and design criteria of an item.

This standard provides requirements for the design, construction, testing, inspection, maintenance, operations, and personnel licensing requirements for lifting devices and equipment used in support of NASA operations. NASA's missions involve many unique hardware and operations. In support of its missions NASA performs many lift operations of high-value one-of-a-kind loads, and of highly hazardous loads. NASA also performs many highly technical lift operations. This standard provides unique requirements for NASA's unique lifting operations. This standard includes the NASA Alternate Standard for Suspended Load Operations, an OSHA alternate standard.

The original NASA Safety Standard for Lifting Devices and Equipment was issued as NSS/GO-1740.9 in July 1982. In July 1988 it was revised, and Revision A was issued, reflecting significant changes related to mobile cranes, hoist-supported personnel platforms, personnel lifting buckets, and guidance concerning NASA critical lifts. In November 1991 it was revised again, and Revision B was issued, which deleted the guidance on super critical lifts and added the NASA Alternate Standard for Suspended Load Operations. Additional revisions were issued as change pages in March 1993 to expand operational test requirements for hoist-supported personnel lifting devices. When the time came to update the standard again, in addition to the technical changes to the document (synopsized in the Revision Log above), the format and numbering were changed to reflect current practices and conventions for NASA standards.

Requests for information, corrections, or additions to this standard should be submitted to the NASA Office of Safety and Mission Assurance by email to Agency-SMA-Policy-Feedback@mail.nasa.gov or via the "Email Feedback" link at https://standards.nasa.gov.

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1. SCOPE

1.1 Purpose

1.1.1 The purpose of this standard is to establish NASA's minimum requirements for, but not all details of, the design, construction, testing, inspection, maintenance, operation, and personnel licensing of lifting devices and equipment (LDE) listed in section 1.2 in order to enhance safety and reliability and ensure compliance with regulatory requirements.

1.1.2 This standard provides unique requirements for NASA lifting operations such as NASA Critical lifts and suspended loads. The requirements in this standard are in addition to those imposed by regulatory bodies such as OSHA or additional government regulations (including applicable host country regulations). The NASA Alternate Standard for Suspended Load Operations contained in Appendix A is an OSHA alternate standard under 29 CFR 1960 and as such is an OSHA standard. This standard provides NASA-specific requirements and references applicable OSHA and Voluntary Consensus Standards (VCS). This standard establishes minimum safety requirements. NASA installations are encouraged to assess their individual lifting programs and develop additional requirements as needed.

1.2 Applicability

1.2.1 This standard is applicable to NASA-owned, rented, leased and NASA contractor-supplied LDE, as defined in section 3.2 used in support of NASA operations at NASA, Headquarters, Centers, Facilities, NASA operations in host countries, and technical and service support centers.

1.2.2 This standard does not apply to earth-moving equipment, elevators, or lifting devices used in non-lifting applications (e.g., balloon launching fixtures, jacks serving only to render casters ineffective).

1.2.3 Appendix A, NASA Alternate Standard for Suspended Load Operations, is not applicable to lifting operations associated with Center lease agreements.

1.2.4 This standard is approved for use by NASA Headquarters and NASA Centers, and Facilities and applicable technical requirements may be cited in contract, program and other Agency documents. It may also apply to the Jet Propulsion Laboratory (a Federally Funded Research and Development Center (FFRDC)), other contractors, recipients of grants and cooperative agreements, and parties to other agreements only to the extent specified or referenced in applicable contracts, grants, or agreements.

1.2.5 Rented or leased LDE used for non-critical lifts may be exempted from this standard by the written decision and collective agreement of the Contracting Officer, the responsible NASA installation or program safety office representative, and the Lifting Devices and Equipment Manager (LDEM), based on an assessment of associated risk.

1.2.6 The need for compliance with this standard at contractor installations performing NASA work should be evaluated and made a contractual requirement, where deemed necessary by the collective agreement of the Contracting Officer, the responsible NASA installation or program safety office representative, and the LDEM.

1.2.7 This standard is not applicable for NASA lift operations in host countries, unless specifically mandated contractually by the NASA program or project.

1.2.8 The LDEM has the authority to interpret this standard. (This is not to be interpreted as authority to change or waive the requirements of this standard.) In cases where interpretation is needed, the LDEM should consult with the program executive.

1.2.9 The LDEM has the authority to approve, disapprove, and levy requirements for the use of LDE not covered by section 1.2.1 due to safety concerns or hazards presented by a particular application.

1.2.10 In this standard, all mandatory actions (i.e., requirements) are denoted by statements containing the term "shall." The terms "may" denotes a discretionary privilege or permission, "can" denotes statements of possibility or capability, "should" denotes a good practice and is recommended, but not required, "will" denotes expected outcome, and "are/is" denotes descriptive material.

1.3 Request for Relief

NPR 8715.1, NASA Safety and Health Programs defines the process for requesting and granting relief from requirements within this standard.

1.4 Using This Standard

1.4.1 This standard provides the minimum NASA requirements for the design, testing, inspection, maintenance, personnel licensing, and operation of LDE. It is not a comprehensive list of all applicable requirements.

1.4.2 The following steps should be taken to identify and comply with all requirements for a particular type of LDE:

a. Address applicable Federal regulations (e.g., CFR, OSHA).

   Note: OSHA regulations are available online at http://www.osha.gov.

b. Address applicable state and local regulations (e.g., Cal/OSHA).

   Note: Some state regulations may be more stringent than NASA requirements.

c. Address the general LDE requirements in section 4 of this standard.

d. Address the LDE-specific requirements, as applicable, in sections 5-13 of this standard.

e. Address applicable VCS as referenced in this standard.

f. Address any applicable Center-level LDE requirements.

Note: The requirements of this standard are the minimum Agency requirements. Additional or more stringent LDE requirements may be developed at each Center.

1.4.3 Contact the LDEM for questions regarding conflicting requirements, the applicability of this standard, or to request a clarification.

1.4.4 Appendix A is the NASA Alternate Standard for Suspended Load Operations and applies to specifically identified NASA controlled lift operations involving civil service and contractor employees.

1.4.5 Appendix B references the LDE recommendations for loaned equipment and out-granted agreements. This appendix gives guidance for Centers that have leased areas or have loaned equipment to other entities outside of NASA. It helps ensure LDE is returned to its original condition.

1.4.6 Appendix C is the Overhead Crane (OHC) Castellated Beam Systems (CBS) Memorandum issued by the Chief Office of Safety and Mission Assurance, dated June 22, 2021. This appendix is used as the basis of the CBS requirements.

1.4.7 Appendix D references the load test and inspection requirements stated throughout this standard.

2. APPLICABLE AND REFERENCE DOCUMENTS

2.1 Applicable Documents

The documents listed in this section are incorporated by reference and contain provisions that constitute requirements of this standard. Use of more recent issues of cited documents may be authorized by the responsible *LDEM. Other VCS not listed below may be considered by the LDEM on a case-by-case basis.* The applicable documents are accessible via the NASA Technical Standards System at https://standards.nasa.gov or may be obtained directly from the Standards Developing Organizations or other document distributors.

2.1.1 Government Documents

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1960	Basic Program Elements For Federal Employee Occupational Safety and Health Programs and Related Matters
NPD 4200.1	Equipment Management Program
NPR 1800.1	NASA Occupational Health Program Procedures
NPR 8715.1	NASA Safety and Health Programs
NPR 8800.15	Real Estate Management Program
Overhead Crane (OHC) Castellated Beam Systems (CBS) Memorandum	issued by the Chief Office of Safety and Mission Assurance, dated June 22, 2021
NASA-STD-8719.12	Safety Standard for Explosives, Propellants, and Pyrotechnics
NASA STI 20210024475	Wire Rope Inspection Report Safety Division, Code 360
NRRS 1441.1	NASA Records Retention Schedules

2.1.2 Non-Government Documents

ANSI/ASNT CP-189-2020	ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel
ANSI/ASNT SNT-TC-1A-2020	Personnel Qualification and Certification in Nondestructive Testing

ANSI/ITSDF B56.1-2020	Safety Standard for Low Lift and High Lift Trucks
ANSI/ITSDF B56.6-2021	Safety Standard for Rough Terrain Forklift Trucks
ANSI/ITSDF B56.10-2019	Safety Standard for Manually Propelled High Lift Industrial Trucks
ANSI/ITSDF B56.14-2020	Safety Standard for Vehicle Mounted Forklift Trucks
ANSI/SAIA A92.2-2021	Vehicle Mounted Elevating and Rotating Aerial Devices
ANSI/SAIA A92.20-2021	Design, Calculations, Safety Requirements and Test Methods for Mobile Elevating Work Platforms (MEWPs)
ANSI/SAIA A92.22-2021	Safe Use of Mobile Elevating Work Platforms (MEWPs)
ANSI/SAIA A92.24-2018	Training Requirements for the Use, Operation, Inspection, Testing and Maintenance of Mobile Elevating Work Platforms (MEWPs)
ASME B30.1-2020	Jacks, Industrial Rollers, Air Casters, and Hydraulic Gantries
ASME B30.2-2022	Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)
ASME B30.3-2019	Tower Cranes
ASME B30.4-2020	Portal and Pedestal Cranes
ASME B30.5-2021	Mobile and Locomotive Cranes
ASME B30.6-2020	Derricks
ASME B30.7-2021	Winches
ASME B30.8-2020	Floating Cranes and Floating Derricks
ASME B30.9-2021	Slings
ASME B30.10-2019	Hooks
ASME B30.12-2021	Handling Loads Suspended From Rotorcraft
ASME B30.13-2022	Storage/Retrieval (S/R) Machines and Associated Equipment
ASME B30.14-2021	Side Boom Tractors

ASME B30.16-2022	Overhead Hoists
ASME B30.17-2022	Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)
ASME B30.19-2021	Cableways
ASME B30.20-2021	Below-the-Hook Lifting Devices
ASME B30.21-2019	Lever Hoists
ASME B30.22-2016	Articulating Boom Cranes
ASME B30.23-2022	Personnel Lifting Systems
ASME B30.24-2018	Container Cranes
ASME B30.25-2018	Scrap and Material Handlers
ASME B30.26-2020	Rigging Hardware
ASME B30.28-2020	Balance Lifting Units
ASME B30.29-2018	Self-Erect Tower Cranes
ASME B30.30-2019	Ropes
ASME PASE-2019	Portable Automotive Service Equipment
CMAA Specification No. 70-2020	Specifications for Electric Overhead Traveling Cranes
CMAA Specification No. 74-2020	Specification for Top Running and Under Running Single Girder Electric Overhead Traveling Cranes
CMAA 78-2014	Standards and Guidelines for Professional Services Performed On Overhead and Traveling Cranes and Associated Hoisting Equipment (Revised 2015)
DIN EN 13000-2014	Cranes-Mobile Cranes
NAS-410-2020	Certification & Qualification of Nondestructive Test Personnel
SNT-TC-1A-2020	Personnel Qualification and Certification in Nondestructive Testing

WSTDA-RS-1-2020	Recommended Standard for Synthetic Polyester Round Slings
WSTDA-WS-1-2019	Recommended Standard for Synthetic Web Slings
	Wire Rope User's Manual-4th Edition
	Wire Rope Sling User's Manual-3rd Edition

2.2 Reference Documents

The documents listed in this section are not incorporated by reference within this standard. These references are included to provide further clarification and guidance.

2.2.1 Government Documents

NPR 8715.7	NASA Payload Safety Program
NASA-STD-8719.24	NASA Payload Safety Requirements
NASA-HDBK-8709.22	Safety and Mission Assurance Acronyms, Abbreviations, and Definitions

2.2.2 Non-Government Documents

ASME BTH-1-2020	Design of Below-the-Hook Lifting Devices
ASME HST-1-2017	Performance Standard for Electric Chain Hoists
ASME HST-2-2018	Performance Standard for Hand Chain Manually Operated Chain Hoists
ASME HST-3-2022	Performance Standard for Manually Lever Operated Chain Hoists
ASME HST-4-2021	Performance Standard for Overhead Electric Wire Rope Hoists
ASME HST-5-2020	Performance Standard for Air Chain Hoists
ASME HST-6-2020	Performance Standard for Air Wire Rope Hoists
NFPA 70-2020	National Electric Code
SAE J1063-2013	Crane Structures, Cantilevered Boom, Method of Test
SAE J1305-2022	Two-Block Warning and Limit System in Lifting Crane Service

SAE J765-2017	Crane Load Stability Test Code

2.3 Order of Precedence

2.3.1 Where conflicts exist between this standard and applicable Federal and state regulations, the applicable regulations take precedence.

Note: This document supplements and provides implementation direction for OSHA regulations. With the exception of Appendix A, NASA Alternate Standard for Suspended Load Operations (which is approved by OSHA), this standard is not a substitute for any OSHA regulation. OSHA regulations stated in the Code of Federal Regulations (CFR) are law and, as such, apply to all NASA operations. Some states have their own OSHA programs, which may apply additional, more stringent regulatory requirements.

2.3.2 Where conflicts exist between this standard and applicable Agency directives, the applicable Agency directives take precedence.

2.3.3 Where conflicts exist between this standard and standards that are incorporated by reference herein, this standard takes precedence, except in the case where those standards are Federal or state regulations.

2.3.4 Where conflicts exist between a general requirement and specific requirement, the specific requirement applies.

2.3.5 Where conflicts exist between a requirement that is meant to be applied generally across all technical disciplines and a requirement that is applicable to a specific technical discipline, the requirement that is applicable to a specific technical discipline takes precedence.

2.3.6 Clarification and further resolution of conflicts is resolved by the responsible LDEM.

2.3.7 VCS requirements are mandatory when required by OSHA regulations or when required by this document as specified herein.

3. ACRONYMS AND DEFINITIONS

3.1 Acronyms and Abbreviations

AGMA	American Gear Manufacturers Association
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASNT	American Society for Nondestructive Testing
BTH	below-the-hook
Cal/OSHA	California Occupational Safety and Health Administration

CBS	castellated beam system
CEN	European Committee for Standardization
CFR	Code of Federal Regulations
CMAA	Crane Manufacturers Association of America
COTS	commercial off-the-shelf
DIN	Deutsches Institut für Normung
E-stop	emergency stop
ESD	electrostatic discharge
ESO	Explosives Safety Officer
FMEA	failure modes and effects analysis
ITSDF	Industrial Truck Standards Development Foundation
LDE	lifting devices and equipment
LDEM	Lifting Devices and Equipment Manager
MEWP	mobile elevating work platform
NCCCO	National Commission for the Certification of Crane Operators
NCCER	National Center for Construction Education and Research
NDE	nondestructive evaluation
NDT	nondestructive testing
NFPA	National Fire Protection Association
NPR	NASA Procedural Requirements
NSS/GO	NASA Safety Standard/Ground Operations
OEM	original equipment manufacturer
OHC	overhead crane
OSHA	Occupational Safety and Health Administration
PAUT	phased array ultrasound

PIT	powered industrial truck
PWRI	physical wire rope inspection
SAE	Society of Automotive Engineers
SAIA	Scaffold and Access Industry Association
SFP	single failure point
SME	subject matter expert
VCS	voluntary consensus standard
VWRI	visual wire rope inspection
WLL	working load limit
WRI	wire rope inspection
WRTB	Wire Rope Technical Board
WSTDA	Web Sling and Tie Down Association

3.2 Definitions

attachment (for industrial trucks). Devices other than conventional forks or load backrest extensions, mounted permanently or temporarily on the elevating mechanism of an industrial truck for handling the load. Common types of attachments include, but are not limited to, fork extensions, clamps, rotating devices, side shifters, and booms.

below-the-hook (BTH) lifting device. A device used for attaching a load to a hoist or other lifting mechanism. The device may consist of or contain components such as slings, hooks, and rigging hardware that are addressed by ASME B30 volumes or other standards. Common types of below-the-hook lifting devices include spreader bars, beam clamps, barrel lifters, and vacuum lifts. Some of these devices may be referred to as structural slings.

brake. A device used for resisting or stopping motion.

castellated beam system (CBS). Also known as zipper tracks, serrated tracks, window tracks, or arch beams. A castellated beam is a beam that consists of an inverted “T” or other geomentric shaped section welded to a separate “T” shaped top section, which then creates multiple “arches” or “windows” throughout the length of the beam. The lower section of the beam consists of a hardened metal flange designed for under-hung running cranes. Weld quality in CBS may not meet current standards and even one weld in the entire system can result in catastrophic failure that occurs all the way down the length of the bridge or runway without warning.

certified equipment. Lifting device or equipment documented by the LDEM as complying with the design, construction, maintenance, test, and other requirements of this standard.

certified wire rope inspector. An inspector who is qualified by third party or NASA in-house approved certified wire rope inspection program.

commercial off-the-shelf (COTS). Any item of supply that is sold in substantial quantities in the commercial market place and is offered to the government without modification in the same form as it is sold in the commercial marketplace.

configuration management. Process for establishing and maintaining consistency of a product's functional and physical characteristics, evaluating and authorizing any changes to those characteristics, and recording and documenting the characteristics and any changes to them to verify compliance with the product's configuration requirements throughout its life.

crane. A machine for lifting and lowering a load and moving it horizontally, with the hoisting mechanism an integral part of the machine.

derrick. An apparatus consisting of a mast or equivalent member held at the end by guys or braces, with or without a boom, for use with a hoisting mechanism and operating ropes.

design factor. A numeric usually expressed as a ratio of the ultimate strength or yield strength to the rated capacity. It is used in calculations to account for variations found in the properties of materials, manufacturing tolerances, operating conditions, and design assumptions.

designated person. A person who is qualified, trained, and selected or assigned (in writing) by the responsible organization to perform specific duties.

eddy current brake. An electrical induction brake used to reduce or control speed.

emergency stop (E-stop). A manually operated switch or valve to cut off electric or fluid power independently of the regular operating controls.

failure modes and effects analysis (FMEA). A systematic, methodical analysis performed to identify and document failure modes and their resultant effects at a prescribed level.

hazard. Any real or potential condition that can cause injury or death to personnel or damage to or loss of equipment or property.

high lift industrial trucks. High lift industrial trucks equipped with an elevating mechanism designed to permit levels of vertical movement including, but not limited to, powered industrial trucks (PIT), platform trucks, picker trucks, reach trucks, manually propelled lift trucks, and high lift pallet jacks. (refer to powered industrial truck definition).

hoist. A machinery unit device used for lifting and lowering a load.

hoist-supported personnel lifting device. Device specifically designed and fabricated to lift and lower persons via a hoist. These devices include hoist-supported platforms where personnel occupy the platform during movement. These devices do not include elevators, mobile aerial platform, or platforms hoisted unoccupied to a position and anchored or restrained to a stationary structure before personnel occupy the platform (refer to Personnel Access Platform).

holding brake. A brake that automatically prevents motion when power is off.

idle lifting device. Lifting device that has not been used for 12 months or more, or that has no projected use for the next 12 months.

jack. A mechanism or appliance with a base and load point designed for lifting and lowering or moving horizontally a load by application of a pushing force. Jacks may be of the following types: Lever and ratchet, screw, strand, and hydraulic used in NASA institutional and mission related ground support.

licensed operator. See Licensed personnel.

licensed personnel. Individuals documented by the LDEM as meeting the personnel licensing requirements of this standard. Licensed personnel may be referred to as certified personnel or certified operators in other regulations and VCS.

lifting device. Items such as overhead and gantry cranes (including but not limited to top running monorail, underhung, and jib cranes), mobile cranes, derricks, hoists, winches used for lifting and lowering, hoist-supported personnel lifting devices, mobile aerial platforms, high lift industrial trucks, and jacks used for lifting, lowering, and positioning a load.

lifting devices and equipment (LDE). See Lifting device and Lifting equipment. Includes: overhead and gantry cranes (including, but not limited to: top running, monorail, underhung, and jib cranes), mobile cranes, derricks, hoists, winches used for lifting applications, hoist-supported personnel lifting devices, load positioning devices (e.g., Hydra Sets®), load measuring devices, hooks, jacks used for NASA Critical lifts, slings, rigging hardware, below-the-hook lifting devices, mobile elevated work platforms, and high lift industrial trucks.

Lifting Devices and Equipment Manager (LDEM). Person designated by the Center Director, responsible for managing the installation's lifting devices and equipment program, coordinating with appropriate personnel at their installation on lifting issues, and providing their installation's position on lifting devices and equipment safety issues.

lifting equipment. Individual pieces or assemblies of components used in the lifting process. Items such as below-the-hook lifting devices, load positioning devices, load measuring devices, hooks, slings, and rigging hardware, used separately or with lifting devices.

load. The total weight of the items being supported, raised, or moved by a lifting device or equipment, including rigging hardware, slings, below-the-hook lifting devices, the load block for some mobile crane configurations, or any other attachments that are not taken into account when determining the rated capacity of the lifting device or equipment.

load brake. A braking device that retards and controls the load during lowering and keeps the load from falling if the holding brake fails.

load measuring device. A device below-the-hook, which is used to indicate the weight of the item being lifted (e.g., load cell, dynamometer).

load positioning device. Instrument installed between the hook and load to allow precise control of lifting operations (e.g., Hydra Sets®).

mobile elevated work platform (MEWP). A mobile device that has an adjustable position platform and is supported from ground level by a structure.

mock load. A test load used to simulate the real load; typically, a test weight.

mock rated load. A test load equal to the rated load of the device; typically, a test weight.

NASA Critical LDE. Lifting devices and equipment used to perform critical lifts.

NASA Critical lift. A NASA Critical lift is a lifting operation during which failure or loss of control of the lift operation would present an elevated risk of serious injury, loss of life, or loss of one-of-a-kind articles, high-dollar items or major facility components whose loss would have serious programmatic or institutional impact. Lifts of high-value loads, such as of high-value flight hardware, or of highly hazardous loads, such as explosives or toxic propellants are classified as NASA Critical lifts. Suspended load operations are also NASA Critical lifts. Lifts that involve, but are not limited to, lift point below center of gravity, lifting explosive and energetic material are classified as NASA Critical lifts. Lifting and movement of flight hardware components packaged per applicable shipment specifications are typically not classified as NASA Critical lifts.

NASA operation. Any activity or process under NASA direct control or that includes major NASA involvement.

NASA technical lift. A NASA Technical lift is a non-critical complex lifting operation requiring additional planning and precautions (e.g., written procedures, resources and documentation) to reliably perform the lift activity. NASA Technical lifts may include but are not limited to: Irregular loads or loads with unusual weight distribution (offset center of gravity), lifts that exceed 75 percent of the mobile crane's load chart capacity, crane lifts over any portion of an occupied building, if the lift involves multiple LDE devices or tandem lifts, complex rigging assemblies (e.g., christmas treeing), lifts out of the operator's view, lifting to or from floating vessels (e.g., Harbor lifting), lifting submerged loads.

non-critical lift. See NASA Technical lift and standard lift.

nondestructive testing and evaluation (NDT/NDE). The application of technical methods to test and examine materials or components in ways that do not impair future usefulness and serviceability in order to detect, locate, measure, and evaluate flaws; to assess integrity, properties, and composition; and to measure geometrical characteristics.

non-load test slings, rigging hardware, and below-the-hook lifting devices. Slings, rigging hardware, and below-the-hook lifting devices meeting the criteria of section 13.3.4 and designated and approved by the LDEM as not subject to periodic load testing requirements.

periodic inspection. A thorough examination of LDE conducted at predetermined intervals (typically monthly to yearly) to assess the condition of the equipment. These inspections do not include pre-use inspections performed each day before the equipment is used. Details of these inspections are provided in regulations and industry standards.

periodic load test. A load test performed at predetermined intervals to determine whether the equipment (e.g., limit switches, E-stop, controls, brakes, slings, shackles) is functioning properly. This includes a functional operational test, not to exceed 100% of the rated capacity, and follows OSHA, VCS, and manufacturer requirements.

personnel access platform. A platform, typically deployed or relocated by one or multiple dedicated hoists or winches, which allow personnel to access and work in a specific area of a fixed structure or building. Personnel occupy these platforms only after the platforms are deployed and secured and never during movement or while the platforms are supported by hoists/winches. For platforms specifically designed to lift and lower persons via a hoist/winch, refer to Hoist-Supported Personnel Lifting Devices.

personnel access platform hoist/winch. A dedicated hoist/winch whose only purpose is to raise and lower a personnel access platform not carrying personnel.

personnel licensing. A means to ensure an individual is qualified to perform a designated task.

physical wire rope inspection (PWRI). A thorough physical inspection, "hand- over-hand," of the entire running rope of an overhead crane by a Certified Inspector familiar with wire rope conditions that may result in appreciable loss of strength.

powered industrial trucks (PIT) Commonly called forklifts, fork trucks, lift trucks, pallet jacks, and order pickers are used in many industries, primarily to move materials. They can be driven by an operator or controlled remotely by a walking operator. This includes, but is not limited to, forklifts, pallet jacks, and powered hand trucks.

proof load. The specific load or weight applied to verify material strength, construction, and workmanship when performing a proof load test (typically uses a load greater than the rated load).

proof load test. A static load test performed prior to first use, after major modification of the load path, or at other prescribed times.

qualified person. A person who, by possession of a recognized degree in an applicable field or certificate of professional standing, or who, by extensive knowledge, training, and experience, has successfully demonstrated the ability to solve or resolve problems relating to the subject matter and work.

rated capacity. See rated load.

rated load. The maximum load a lifting device or equipment is designed to lift under normal operating conditions. This value may be marked on the device indicating maximum capacity. This is also the load referred to as "safe working load or the working load limit." If the device has never been downrated or uprated, this also is the "manufacturer rated load."

recognized licensing organization. Operator licensing organization meeting industry and OSHA recognized criteria for written testing materials, practical examinations, test administration, grading, facilities/equipment, and personnel [e.g., National Center for Construction Education and Research (NCCER), National Commission for the Certification of Crane Operators (NCCCO)].

regular service LDE. LDE used one or more times per month.

remote emergency stop (Remote E-stop). A manually operated switch or valve to cut off electric or fluid power independently of the regular operating controls that is located remotely from the operator control station.

request for relief. Documented request for permission to perform some act contrary to established requirements.

responsible organization. Entity or a representative thereof responsible for the design, operation, maintenance, testing, inspection, or personnel training and licensing of LDE. (In some cases, this may be the LDEM).

rigging hardware. A detachable load supporting device such as a shackle, link, eyebolt, ring, swivel, or clevis.

safe working load. See rated load.

safety factor. The ratio of the breaking strength to the working load limit that may be either mandated by OSHA or perscribed by the manufactuer. Also see Design factor.

signal person. A signal person is a designated person that may require qualification or training tasked with the responsibility to communicate with the operator of LDE during load handling operations.

single failure point. A single item or component whose failure would cause an undesired event such as dropping a load or loss of control.

sling. A flexible lifting assembly and incorporated hardware used between a lifting device and the payload being lifted. Common types include wire rope slings, synthetic round slings, metal mesh slings, synthetic web slings, and chain slings.

spotter. A person that serves as a second pair of eyes and ears for drivers and equipment operators on the jobsite to ensure safety of the operation to include equipment, facility, and personnel.

standard lift. A non-critical lift operation involving routine lifting operations which do not require unique documented plans and precautions. Standard lifts are governed by standard industry rules and practices, and are supplemented with unique NASA testing, operations, maintenance, inspection, and personnel licensing requirements contained in this standard. Typical lifts that have no additional hazards or obstructions, simple load geometry, simple rigging, routine task that is covered by a job hazard analysis, familiar repetitive lifts preformed previously. Example: moving shop materials.

standby LDE. LDE not in regular service but used occasionally or intermittently as required. A lifting device or equipment that has not been used for a period of 1 month or more but less than 12 months is considered to be used intermittently/occasionally.

structural sling. A term sometimes used for rigid or semi-rigid lifting devices such as spreader bars or lifting beams that now are included in the general category of below-the-hook lifting devices.

surface nondestructive testing. Test and inspection methods used to examine the surface of equipment/materials (e.g., magnetic particle and liquid penetrant).

two-block. A condition in which the lower load block or hook assembly comes into contact with the upper load block, hoist/trolley structure, or boom point sheave assembly, which can cause catastrophic failure of the wire rope, load block, or sheave assembly.

visual wire rope inspection (VWRI). A thorough visual inspection, from the ground or a fixed platform, of overhead crane wire rope by a Qualified Person familiar with wire rope conditions that result in appreciable loss of strength. Conditions include gross damage, such as loss of core support, internal or external corrosion, broken wires, and severe kinking, crushing, cutting or unstranded wire rope.

volumetric nondestructive testing. Test and inspection methods used to examine the interior of equipment/materials (e.g., ultrasonic and radiographic).

voluntary consensus standards (VCS). Industry standards used by NASA for LDE design, operations, maintenance, and inspections, including American Gear Manufacturers Association (AGMA), American Society of Mechanical Engineers (ASME), Deutsches Institut für Normung (DIN), American National Standards Institute (ANSI), and Scaffold and Access Industry Association (SAIA).

winch. A stationary motor-driven or hand-powered hoisting machine having a drum around which is wound a rope, chain, or web used for lifting and lowering a load (requirements in this standard do not apply to winches used for horizontal pulls).

wire rope inspection (WRI). See visual wire rope inspection.

working load limit (WLL). See rated load.

4. GENERAL LDE REQUIREMENTS

4.1 General

4.1.1 Section 4 contains general LDE requirements. Subsequent sections provide additional requirements specific to individual types of LDE.

4.1.2 The Center or /facility LDE program shall be managed in accordance with NPR 8715. and the requirements in this standard.

4.1.3 LDE shall be designed, constructed, tested, inspected, maintained, and operated in accordance with the applicable OSHA regulations, the requirements in this standard, VCS as specified herein, and be based upon manufacturer recommendations.

Note: Section 2 contains a list of OSHA regulations and applicable VCS incorporated by reference. Refer to the specific LDE sections for any additional requirements.

4.1.4 LDEM approval shall be obtained for any tailoring of manufacturer recommendations.

4.2 Classification of Lifts

4.2.1 There are two categories of lifting operations for the purposes of this standard: NASA Critical lifts and non-critical lifts. Additionally, there are two subcategories of non-critical lifts: NASA Technical and standard, which are addressed in this section. Requirements for non-critical LDE, NASA Critical lifts, and NASA Critical LDE are specifically addressed throughout the document. Non-critical lift requirements identified in this document apply to both standard and NASA Technical lifts. The responsible organization shall follow a documented process that seeks input from the appropriate stakeholders (such as facility, program, operations, the Explosives Safety Officer and other Center Institutional Safety Discipline Leads, and safety) and the LDEM to classify lifts as NASA Critical, NASA Technical or standard.

4.2.2 An operation shall be classified as a NASA Critical lift when failure or loss of control presents an elevated risk of serious injury, loss of life, or loss of one-of-a-kind articles, high-dollar items or major facility components whose loss would have serious programmatic or institutional impact.

Note: Lifts of high-value spacecraft are usually classified as NASA Critical lifts, while lifts of small, improvised mini satellites, for example, most likely would not be. Lifting and movement of flight hardware components packaged per applicable shipment specifications may be classified as standard or NASA Technical with input from stakeholders.

4.2.3 An operation shall be classified as a NASA Technical lift when the lift operation is not critical but is complex requiring enhanced planning to ensure safety and the success of the lift.

4.2.4 An operation is classified as a standard lift when the lift involves routine lifting operations and is governed by OSHA regulations, VCS, and supplemented with unique NASA testing, operations, maintenance, inspection, and personnel licensing requirements contained in this standard, and when not a NASA Critical or NASA Technical lift.

4.2.5 NASA Programs and Projects shall designate all lifts that involve programmatic high value, one-of-a-kind flight hardware, or have adverse programmatic impacts as NASA critical lifts.

4.2.6 The LDEM has the authority to reclassify lifts based on potential harm to personnel, adverse effects to the environment, collateral damage to facilities, and impact to LDE.

4.2.7 The LDEM may not reclassify the lift based on the perceived value or programmatic importance of the load or hardware to be lifted.

4.2.8 Lifting of personnel using hoist-supported personnel lifting devices shall be classified as a NASA Critical lift.

4.3 Safety Hazard Analysis

4.3.1 Equipment hazard analysis shall be performed on NASA Critical or custom-built LDE for review and concurrence by the LDEM.

4.3.2 Hooks, rigging hardware, slings, and below-the-hook lifting devices may be excluded from the equipment hazard analysis for cases in which there is no potential for load instability subject to documented LDEM approval.

> *Note: Some one-of-a-kind, custom-built LDE may be more likely to break down and should be considered less reliable than commercial off the shelf (COTS) equipment. Given this, original equipment manufacturer (OEM)-type LDE should be used, when possible, rather than custom, built-up equipment. For an equipment hazard analysis, a failure modes and effects analysis (FMEA) may be acceptable.*

4.3.3 The operational hazard analysis shall, as a minimum, identify potential sources of danger and recommend resolutions for those conditions that could cause loss of life, personal injury, and loss of or damage to the LDE, facility, or load.

> *Note: Operational Safety Hazard Analysis may apply to NASA Critical, NASA Technical and Standard lifts at the discretion of the LDEM.*

4.4 Design

4.4.1 Per section 4.1.3, LDE shall be designed and constructed in accordance with the applicable OSHA regulations, the requirements in this standard, VCS as specified herein and be based on manufacturer recommendations.

4.4.2 If NASA Critical or custom-built LDE is designed or procured, the responsible organization shall notify and provide the LDEM with the necessary information for review and approval of the design/procurement prior to use of the hardware (subject to documented LDEM approval, hooks, rigging hardware, and slings may be excluded from this requirement).

4.4.3 LDE design shall provide for visual and physical accessibility for safe inspection, service, repair, and component replacement.

4.5 Testing

4.5.1 Per section 4.1.3, tests shall comply with the applicable OSHA regulations, the requirements in this standard and VCS as specified herein and be based upon manufacturer recommendations. In accordance with section 4.1.4, tailoring of manufacturer recommendations for testing requires LDEM approval.

4.5.2 Two types of tests are specified for LDE in this standard: proof load tests and periodic load tests. The required tests and test parameters will vary according to the specific LDE. Refer to the applicable LDE sections for specific requirements and additional information.

Note: Periodic load tests are limited to a value below that of proof tests but not to exceed the working load limit unless otherwise specified in this standard.

4.5.3 Designated and qualified persons shall perform all load tests in accordance with written procedures.

4.5.4 LDE shall undergo a proof load test:

a. Prior to first use for all new LDE.

b. Prior to being placed back into service after repairs or modifications that affect load holding capability or load bearing components (e.g., welding on components in the load path).

c. After wire ropes or load chains are replaced.

4.5.5 A periodic load test shall also be performed whenever a required proof load test is performed.

Note 1: For mobile elevating work platforms (MEWPs), powered industrial trucks and their attachments, load measuring devices, and jacks, the proof load test consists of performing a periodic load test.

Note 2: For slings, rigging hardware, and below-the-hook lifting devices, performance of a proof load test satisfies the periodic load test requirement for that load test cycle.

4.5.6 A periodic load test shall be performed on all LDE within one year prior to its use in NASA Critical lift operations.

Note: Other periodic load test requirements are specified in applicable sections of this standard, OSHA, and VCS.

4.5.7 Periodic load testing of extensively repaired or modified LDE may be limited to the functions affected by the repair or modification, only if the periodic load test interval has not expired.

4.5.8 Periodic load test intervals may be extended by no more than 90 days from the original expiration date due to programmatic or institutional needs, subject to LDEM approval. To extend the periodic load test interval, the following conditions shall be met:

a. The responsible organization provides documented rationale to the LDEM.

b. The LDEM determines there is no increase in risk.

4.5.9 Repaired or modified LDE components that do not affect the lifting or holding capability of the LDE shall undergo a functional check to verify the component repairs or modifications are acceptable prior to the LDE being placed back into service.

4.5.10 Load testing should be conducted in an area where minimal damage will occur if the LDE fails.

4.5.11 An inspection of the LDE and its components shall be performed prior to and after each load test to ensure there is no damage before releasing the LDE into service.

4.5.12 Tests shall be current before Idle and Standby LDE are returned to service.

Note: Testing and inspection are not required while LDE is in Idle or Standby status.

4.6 Inspection

4.6.1 Per section 4.1.3, daily, frequent, periodic, and pre-use inspections shall be performed in accordance with applicable OSHA regulations, the requirements in this standard and VCS as specified herein and be based upon manufacturer recommendations. Per section 4.1.4, tailoring of manufacturer recommendations for inspections requires LDEM approval.

4.6.2 Designated and qualified persons shall conduct all required frequent and periodic LDE inspections.

Note: Certified LDE operators can perform pre-use or pre-operational inspections.

4.6.3 Periodic inspections shall be conducted in accordance with written procedures.

4.6.4 A periodic inspection shall be performed on all new, extensively repaired, or extensively modified LDE prior to first use.

Note: For component repair on LDE, only the inspections that apply to the repaired portion need to be performed prior to first use if the periodic inspection interval has not expired.

4.6.5 Inspections shall be current before Idle and Standby LDE are returned to service.

Note: Testing and inspections are not required while LDE is in Idle or Standby LDE status.

4.6.6 Wire Rope Inspection

4.6.6.1 Centers shall develop a local LDE Wire Rope Inspection (WRI) Program in accordance with this standard to ensure compliance with the following:

a. Develop and maintain written Wire Rope Inspection procedures, pass/fail criteria, inspection findings, and inspection results.

b. Identify inspection frequency and types to include thorough visual and physical inspections by Qualified Person(s) based on the operational status and condition of the LDE.

c. Document training requirements for the Qualified Person and Certified Wire Rope Inspector who will perform WRI inspections, including physical wire rope inspection (PWRI) and visual wire rope inspection (VWRI).

d. Perform applicable risk analysis to determine wire rope physical inspection frequency for LDEs used in harsh non-standard environments (i.e., plating shops, outdoors, near the ocean, certified clean rooms where non-lubricate WR might be used, or as determined by the LDEM).

4.6.6.2 Centers shall update WRI program based on changes in OHC operations and environmental use. WRI analyses shall be revalidated every 4 years.

Note: Center wire rope inspection procedures must be on file with the Center's SMA office.

4.6.6.3 Active OHC systems and OHCs shall also receive and document:

a. A pre-operation VWRI by a Qualified Person as part of the daily pre-lift checkout.

b. An annual PWRI by a certified third party or in-house Center Certified Wire Rope Inspector.

c. Wire rope changeout /replacement frequencies

Note: Additional WRI guidance can be found in NASA STI 20210024475, "Wire Rope Inspection Report Safety Division, Code 360," available at https://ntrs.nasa.gov/api/citations/20210024475/downloads/WRI_Final_V3.docx.pdf.

4.7 Operation

4.7.1 Per section 4.1.3, LDE operations shall comply with the applicable OSHA regulations, the requirements in this standard and VCS, and be based upon manufacturer recommendations.

Per section 4.1.4, tailoring of manufacturer recommendations for operations requires LDEM approval.

4.7.2 For all NASA lifting operations, certified lifting equipment shall be used.

4.7.3 For all lifts, a designated person responsible for the safety of the operation shall be present.

Note: For standard lifts involving minimal risk, the equipment operator may serve as the designated person.

4.7.4 The effects of weather conditions on lift safety shall be evaluated prior to performing LDE operations.

Note: Operations are generally permitted without restriction during electrical storms within enclosed metal or framed buildings that are properly grounded.

4.7.5 LDE found in an unsafe operating condition shall be removed from service.

4.7.6 LDE problems and discrepancies shall be documented and dispositioned prior to use.

4.7.7 LDE shall be verified to be within inspection and testing intervals prior to use.

4.7.8 LDE shall not be loaded beyond its rated load except for required testing.

Note 1: Follow applicable OSHA regulations when testing LDE.

Note 2: 29 CFR 1926 requires knowledge of the weight of the load.

4.7.9 If radio or other communications are to be used, operators or lift supervisors shall test the communication system prior to each operation.

4.7.10 Operations shall stop immediately upon communication loss and cannot continue until communication is restored.

4.7.11 Specific written procedures shall be prepared and followed for NASA Critical lifts and NASA Technical lifts.

4.7.12 Lifting explosive and energetic materials and other non-standard loads shall meet the following requirements.

4.7.12.1 Before lifting explosive and energetic materials and other non-standard loads, the need for special provisions on LDE, which mitigate any hazards caused by the load, shall be assessed and documented by the appropriate subject matter expert (SME) stakeholder. Refer to NASA-STD-8719.12, Safety Standard for Explosives, Propellants, and Pyrotechnics, for requirements applicable to explosives handling and processing.

Note 1: Non-standard loads include, but are not limited to, flammable or energetic materials, such as explosives, pyrotechnics, or propellants; batteries; spacecraft with *special electrostatic discharge (ESD) concerns; pressure vessels not fitted with lifting lugs; hazardous waste, and materials.*

Note 2: Non-standard loads also include ESD sensitive equipment and hardware.

Note 3: Refer to NPR 8715.1 for relevant subject matter areas and your local Center letters of designation for applicable SMEs.

Note 4: Lift owners are responsible for coordinating with all SMEs to mitigate any hazards caused by the load.

4.7.12.2 Explosives Safety Officer (ESO) or their designee shall be a required signature on NASA Critical lift plans involving explosives and energetic materials.

4.7.12.3 Facility grounds and equipment bonding points on LDE shall be validated annually by the Explosives Safety Officer (ESO) or their designee and be recorded prior to lifting operations.

4.7.12.4 The hardware owner shall identify electrically sensitive loads that require grounding during lift operations.

4.7.12.5 LDE operator and other designated persons shall confirm ground continuity and proper grounding to the LDE prior to attaching the load to an LDE (crane hook, forklift, etc.).

4.7.13 Center LDE program shall identify additional LDE operations that require spotters, such as operating in proximity to flight hardware.

Note: Section 10.5.1 requires a spotter for forklift-lifts and forklift-transports through overhead roll up doors and gates not in the fully open position.

4.7.14 Center LDE programs shall include a written policy and work instructions to preclude the use of non-certified LDE.

4.7.14.1 The documented process shall include:

a. How equipment will be placed into a non-operational status.

b. Notification of affected users.

c. How equipment will be safely returned to operational status.

4.7.14.2 The center LDE policy and work instructions shall be coordinated with the Center's SMA office for SMA oversite.

4.7.15 Centers shall assess the need and implement local policy and guidance to address safety risk by securing non-essential LDE during long-term center shutdowns, e.g. Government furlough. All NASA Lifting Standard requirements shall remain in effect and unchanged during long term shutdowns. Programs and operations that continue during government shutdowns are responsible for proper resource allocation to ensure all operations involving LDE remain in compliance with this standard.

4.7.15.1 Policy shall address methods to Control Hazardous Energy, 29 CFR 1910. 147 of non-essential LDE while essential long-term activities continue within a safety impact area of the non-essential LDE. Methods of control may include but are not limited to: NE facility/location securing, work area access restrictions, LDE placed in standby classification (limiting routine time-based maintenance) , deactivation of LDE, LDE tagging, LOTO, removal of keys.

4.7.15.2 Guidance shall include non-essential LDE reactivation during long-term shutdowns, removal of securing devices, notification to users and area occupants, documented LDE.

4.8 Maintenance

4.8.1 Per section 4.1.3, LDE maintenance programs shall comply with the applicable OSHA regulations, the requirements in this standard and VCS as specified herein, and be based upon manufacturer recommendations. In accordance with section 4.1.4, tailoring of manufacturer recommendations for maintenance requires LDEM approval.

4.8.2 The maintenance program shall include procedures and a scheduling system for normal periodic maintenance items, adjustments, replacements, and repairs.

4.8.3 Maintenance safety precautions shall be taken in accordance with OSHA, the applicable VCS as specified herein, and be based upon manufacturer recommendations.

4.8.4 LDEM approval shall be obtained for any modifications to LDE.

Note: Replacement in kind or repairs are not considered a modification and do not require LDEM approval.

4.9 Labeling and Tagging

4.9.1 Per section 4.1.3, labeling and tagging of LDE shall comply with the applicable OSHA regulations, the requirements in this standard and VCS as specified herein, and be based upon manufacturer recommendations.

4.9.2 The rated load shall be plainly marked on LDE.

Note 1: For some types of equipment, a capacity plate affixed to the LDE, or a load chart kept on the LDE is acceptable. Consult OSHA and applicable VCS.

Note 2: Hooks that are part of other LDE, and attachments that are permanently mounted on industrial trucks, do not need separate marking.

4.9.3 NASA critical LDE shall be marked conspicuously as such.

Note: Hooks that are part of NASA Critical LDE, and attachments that are permanently mounted on industrial trucks, do not need separate marking.

4.9.4 Following each periodic load test, a durable tag shall be affixed to the LDE identifying the equipment and stating the next required periodic load test date or load test expiration date.

Note 1: See Section 13 Slings, Rigging Hardware, and Below-the-Hook Lifting Devices for additional requirements.

Note 2: Hooks that are part of other LDE and attachments that are permanently mounted on industrial trucks do not need separate marking.

4.9.5 Idle and Standby LDE shall be conspicuously marked as such.

4.10 Records

4.10.1 The responsible organization shall ensure:

a. Test, inspection, and maintenance records comply with the applicable OSHA regulations and VCS.

b. Records of each test and periodic inspection are generated.

Note: Consult OSHA and VCS for additional documentation requirements.

c. LDE maintenance records are generated.

d. LDE record retention is in accordance with NRRS 1441.1, NASA Records Retention Schedules.

e. LDE and its status are tracked and controlled using a configuration management system.

4.11 Personnel Training and Licensing

4.11.1 General

4.11.1.1 Personnel operating OHCs, powered hoists, MEWP, powered industrial trucks, and mobile cranes shall be appropriately trained and licensed.

Note: This standard does not require LDE operators be licensed to operate manually operated hoists and winches, personnel access platform hoists/winches, manually operated mobile platforms, manually operated industrial trucks, manually operated load positioning devices, load measuring devices, and jacks. Additional licensing and training may be required by Center policy or the LDEM.

4.11.1.2 A training, examination, and licensing program shall be established.

4.11.1.3 For NASA in house training programs, instructors shall be qualified and experienced to administer both formal and practical instruction and test(s) applicable to the center LDE.

Note: For those NASA installations without a training program, LDE operators may be trained and licensed by a recognized licensing organization.

4.11.1.4 Center mobile crane operators shall be certified by a nationally recognized and accredited 3rd party training provider, e.g. NCCCO or equivalent.

4.11.1.4.1 Center LDEM shall approve equivalent 3rd party training providers.

4.11.1.4.2 Mobile crane operator certification shall be in accordance with section 6.4.2 of this document.

4.11.1.5 Licenses shall indicate the type of LDE the holder is qualified and authorized to operate.

Note: The responsible organization may elect to maintain a master list of licensed operators instead of issuing individual licenses, provided copies of the list are readily available to assurance and supervisory personnel at the worksite.

4.11.1.6 Rigging shall be performed by designated or qualified persons.

Note: LDE operators may perform rigging tasks for which they are trained and qualified.

4.11.1.7 Nondestructive testing and evaluation (NDT/NDE) personnel shall be certified in accordance with a nationally or equivalent internationally recognized NDT/NDE personnel qualifications practice or standards, such as ASNT-CP-189, SNT-TC-1A, NAS-410.

Note: Routine visual inspections that are part of daily, frequent, periodic, and other LDE inspections as outlined in OSHA, VCS, and this document are not considered NDT/NDE for the purposes of personnel licensing.

4.11.1.8 Signal persons shall be trained on the types and application of signals and LDE operations in accordance with VCS as specified herein.

Note: OSHA 29 CFR 1926.1428 requires signal persons be qualified.

4.11.2 Licensing Program

4.11.2.1 Licensing programs shall comply with the applicable OSHA regulations, be based upon VCS specified herein, and manufacturer recommendations.

4.11.2.2 A responsible organization shall oversee the issuance of personnel licenses.

4.11.2.3 Licensing organizations and the LDEM shall reserve the right to suspend or revoke licenses for reasons such as negligence, violations of requirements, or failure to meet medical standards documented in NPR 1800.1, NASA Occupational Health Program Procedures.

4.11.2.4 Initial licensing, training, and examination for LDE operators shall include the following as a minimum:

a. Training in safety, lifting equipment emergency procedures, general performance standards, requirements, pre-operational checks, and safety-related defects and symptoms.

b. Hands-on training.

c. Written examination.

d. Operational demonstration.

e. Operator qualifications:

(1) Physical examination of licensed operators shall be in accordance with NPR 1800.1, NASA Occupational Health Program Procedures.

(2) Physical examination of licensed Powered Industrial Truck Operators shall be in accordance with ANSI ITSDF B56.1/B56.6.

4.11.2.5 Licenses are valid for no longer than four years, contingent upon meeting training requirements and maintenance of a current physical examination in accordance with NPR 1800.1. See Table 1 for specific certification periods per the license type.

Table 1 Certification Periods Per License Type

Operator License Type	Certification Period
Mobile Crane Overhead Crane and Powered Hoists Mobile Elevated Work Platform	4 Years
Powered Industrial Truck	3 Years

Note: Rigger and Signal Persons do not have licensing requirements, but training or qualification must be renewed every 4 years.

4.11.2.6 Licensing organizations shall establish renewal procedures that include:

a. A written examination and operational demonstration, at a minimum.

b. Training in safety, lifting equipment emergency procedures, general performance standards; requirements; pre-operational checks; safety-related defects and symptoms; and hands-on training, as needed.

c. Verification of compliance with NPR 1800.1 requirements regarding physical examination of licensed personnel.

4.11.2.7 Licensing shall be revoked if personnel do not maintain compliance with licensing requirements.

4.11.2.8 The LDEM shall review the personnel licensing program at least annually to ensure the contents, training material, testing, and examination elements are up to date with current methods and techniques, and any “lessons-learned” are adequately addressed.

5. OVERHEAD CRANES

5.1 General

5.1.1 The requirements contained in section 5 are applicable to overhead cranes including gantry, top running or underhung, monorail, and jib cranes.

5.1.2 Per section 4.1.3, design, construction, testing, inspection, maintenance, and operation of overhead cranes shall comply with the applicable OSHA regulations, the requirements in this standard ASME B30 series standards (ASME B30.2, ASME B30.11, ASME B30.17, or ASME B30.24), CMAA Specification 70 or 74, and CMAA 78 or equivalent, as approved by the LDEM. Additionally, operation, testing, inspection, and maintenance of overhead cranes shall be based upon manufacturer recommendations.

5.2 Design

5.2.1 Per section 4.1.3, design and construction shall comply with the applicable OSHA regulations, the VCS specified at the beginning of this section, the requirements in this standard (note section 4.4), and the following:

5.2.2 Mechanical

5.2.2.1 Cranes used for NASA Critical lifts shall have one of the following:

a. Two holding brakes, each capable of bringing a rated load to zero speed and holding it.

Note: A load brake may be considered a second holding brake provided it is capable of bringing a rated load to zero speed and holding it.

5.2.2.2 A single holding brake in combination with a motor drive that automatically monitors brake functionality and motor torque.

5.2.2.3 Holding brake(s) shall be applied automatically when power to the brake is removed.

5.2.2.4 The brake design should provide for emergency load lowering.

5.2.2.5 When used for NASA Critical lifts, speed reduction from the motor to the drum on the hoist should be achieved by using gears enclosed in a gear case. If open gears are required, they shall be guarded, with provision for lubrication and inspection.

5.2.2.6 Worm gears shall not be used as a braking means unless the lead angle prevents back driving.

Note: The braking properties of a worm gear tend to degrade with use; the design engineer should consider this in existing installations where the hoist is subject to heavy use or when purchasing new equipment.

5.2.2.7 Cast iron components shall not be used in the hoist load path unless approved by the LDEM and the responsible organization.

Note: The material properties of cast iron allow catastrophic failure (brittle fracture), and it should not be considered as reliable as steel or cast steel. The engineer should consider this when selecting equipment and avoid the use of load-bearing cast iron materials where possible.

5.2.3 Electrical

5.2.3.1 Emergency stops (E-stops) shall open the mainline contactor or the main circuit breaker.

5.2.3.2 Emergency lighting and other personnel safety circuits may remain powered after remote E-stop actuation.

5.2.3.3 Operator E-stops shall be controlled by a red emergency stop button accessible to the operator.

5.2.3.4 In cases where the operator's view is restricted/obstructed, the requirements of section 5.5.5 apply.

5.2.3.5 Remote E-stops shall be:

a. Located where the E-stop operator(s) can clearly see the load and lift area(s).

b. Operated separately from, and take precedence over, the operator control circuit.

c. Operated by a standardized hand-held remote E-stop pendant that includes power and circuit continuity indications.

5.2.3.6 Cranes used for NASA Critical lifts shall be equipped with dual upper limit switches.

5.2.3.7 For NASA Critical lift electric cranes, the limit switches shall meet the following:

a. The initial upper limit switch precludes movement in the raise direction when the limit is reached.

Note: Movement in the "lower" direction need not be inhibited in association with the initial upper limit switch function.

b. The final upper limit switch is wired into the mainline circuit, hoist power circuit, main contactor control circuit, or hoist power contactor control circuit, so that all crane motion or all hoist motion are precluded when the limit is reached.

c. After a final upper limit switch has been activated, movement of the load requires action (resetting) at the final upper limit switch level.

Note: The crane design should include a means of detecting limit switch failure and allow for safe inspection and repair. For example, a system may be equipped with two different colored annunciator lights, one for each limit switch. A reset button may be included so when a final upper limit switch is tripped, the load can be lowered immediately. The reset button should be secured to prevent unauthorized or unintended use.

d. The initial upper limit switch is adjusted sufficiently low to preclude inadvertent actuation of the final upper limit switch if the hoist actuates the initial upper limit switch at full speed with no load. Similarly, the final upper limit switch is adjusted sufficiently low to ensure the hoist will not two-block (or otherwise damage wire rope) if the hoist actuates the final upper limit switch at full speed with no load.

Note: This requirement effectively lowers the usable hook height of the hoist.

5.2.3.8 For cranes used for NASA Critical lifts, a lower limit switch shall be provided to ensure no less than two wraps remain on the drum.

Note: Movement in the "raise" direction need not be inhibited in association with the lower limit switch function.

5.2.3.9 NASA critical lift cranes should have a fail-safe control system, so a single failure does not cause the crane to operate at a speed faster than commanded or in a direction other than commanded.

Note: A failure that stops the crane and sets the brakes or causes the crane to operate at a speed slower than commanded without disabling the stop function is acceptable.

5.3 Testing

Per section 4.1.3, tests shall comply with the applicable OSHA regulations, the VCS specified at the beginning of this section, the requirements in this standard (note section 4.5), and be based upon manufacturer recommendations.

5.3.1 Proof Load Test

5.3.1.1 Proof load tests, stipulated in section 4.5, shall be performed with a mock load of 1.20 to 1.25 times the rated capacity of the crane.

5.3.1.2 Proof load tests shall be conducted after the crane has been installed at the site or facility in which it will be used.

5.3.1.2.1 Loads shall be held for a time sufficient to verify no drift occurs.

5.3.1.2.2 Refer to section 12.3 for hook NDT/NDE requirements.

5.3.2 Periodic Load Test

5.3.2.1 Per section 4.5, a periodic load test and inspection shall be performed whenever a proof load test is required.

5.3.2.2 A periodic load test shall be performed on each overhead crane at least once every four years.

5.3.2.3 The periodic load test shall consist of the following:

a. With a mock load equal to 0.95 to 1.00 times the crane's rated capacity:

(1) Raise and lower the load at various speeds to ensure the hoist is functional under load.

Note: Consult the LDEM regarding appropriate range of travel.

(2) Travel the load at various speeds to ensure the bridge and trolley are functional under load.

Note: Consult the LDEM regarding appropriate range of travel.

b. Test the holding brakes in one of the following ways:

(1) Statically test each brake (under no load) to the design rated torque at the point of brake application.

(2) Check each brake for its ability to hold a static mock load equal to 0.95 to 1.00 times the crane's rated capacity.

Note 1: Note 1: It must be possible to reactivate the out-of-circuit brake.

Note 2: Note 2: This requirement applies to worm gears or load brakes used as holding brakes.

(3) Other methods as approved by the LDEM.

c. Test all E-stop switches with no load on the hook by operating the E-stop and verifying all crane motions are precluded.

d. Test all limit switches with no load on the hook by operating the crane at slow speed into the limit switch and verifying the appropriate crane motion is precluded.

Note: For cranes equipped with dual upper hoist limit switches, the final upper limit switch may be tested by manually tripping the switch and verifying all hoist motion is precluded.

e. Test safety devices when possible.

Note: It is not always possible to test safety devices (e.g., circuit breakers and thermal overload protection).

5.3.2.4 Refer to section 12.3 for hook NDT/NDE requirements.

5.4 Inspection

5.4.1 Per section 4.1.3, OHC inspections shall comply with the applicable OSHA regulations, the requirements in this standard (note sections 4.6 and 5.1.2) and VCS specified at the beginning of the section, and be based upon manufacturer recommendations.

5.4.2 The Overhead Crane (OHC) Castellated Beam System (CBS) memorandum dated June 22, 2021, and attached as Appendix C, provides additional requirements for the inspection and monitoring of CBS until they are phased out.

5.4.2.1 Per Appendix C, Centers shall establish, implement, and document an inspection and monitoring plan for all OHC CBS remaining in operation. The inspection plan must include a visual inspection of all welds to occur at a minimum of once a year. A detailed NDE inspection [magnetic particle (MT), dye penetrate (DT), ultrasonic (UTT), phased array ultrasound (PAUT), etc.] of all welds is to occur at a minimum of once every four years.

5.4.2.2 Centers shall develop a long-term strategy for phased replacement of active CBS with a target goal by 2028.

5.4.2.3 All NDT/NDE inspection personnel shall meet the minimum qualifications in SNT-TC-1A as a Level II inspector.

5.4.2.4 Inspections shall be documented by indexing and photographing each weld on both sides of the beam.

5.4.2.5 A final written inspection report documenting weld conditions shall be generated and signed by the qualified inspector.

5.4.2.6 Any deficient findings, especially crack indications, shall require the OHC to be immediately taken out of service. Repairs to CBS rails are not permitted.

5.4.2.7 Inspection reports shall be filed with the annual OHC certification records.

5.4.2.8 The final reports with required documentation shall be submitted to the LDEM for review.

5.4.3 Wire Rope Inspection

5.4.3.1 Active OHC systems and OHCs shall also receive and document:

a. A pre-operation VWRI by a Qualified Person as part of the daily pre-lift checkout.

b. An annual PWRI by a certified third party or in-house Center Certified Wire Rope Inspector.

c. WRI changeout /replacement frequencies.

5.5 Operation

5.5.1 Per section 4.1.3, operations shall comply with the applicable OSHA regulations, the requirements in this standard (note section 4.7) and the VCS identified at the beginning of this section, and be based upon manufacturer recommendations.

5.5.2 Methods and procedures should be developed for lowering a load in the event of crane failure or other contingencies. These should be demonstrated and verified if practical.

5.5.2.1 Use of overhead cranes for load testing items such as slings, platforms, and lifting fixtures or to relieve a portion of the weight of a constrained load shall be subject to the following conditions:

a. The crane is specifically identified and documented for such use and approved by the LDEM.

b. A load measuring device is installed in the lifting assembly.

c. The crane is not used to load test items by pulling against the ground or against an otherwise fixed object.

d. The total measured load on the crane is not to exceed 50 percent of the rated capacity of the crane when performing the following activities:

(1) Load testing an item at greater than its periodic load test value as stipulated in this document.

Note: Refer to section 13.3 for additional restrictions on testing certain types of slings above their rated capacities.

(2) Load testing an item by pulling against an object whose weight exceeds the desired test load.

(3) Relieving a portion of the weight of a constrained load.

e. The load is only applied vertically.

f. When load testing an item freely suspended from the hook, the test weight is not to be lifted more than six inches above the floor/working surface or above the lowest reasonable height based on test item dimensions and configuration, subject to approval by the LDEM.

g. The crane or lifting assembly (e.g., load positioning device) is to have sufficient fine motion capability to precisely control movement of the load to avoid crane overload or damage to the item when performing the following activities:

(1) Load testing an item by pulling against an object whose weight exceeds the desired test load.

(2) Relieving a portion or all the weight of a constrained load.

h. When a crane is used to load test an item by pulling against an object, the total weight of all objects in the load path is not to exceed the rated capacity of the crane.

5.5.3 If conventional means of reaching a worksite such as an aerial platform, ladder, stairs, or scaffold would be more hazardous, or if access is not possible because of structural design or worksite conditions, and it is determined personnel must be lifted with a crane, the requirements of 29 CFR 1926 for mobile cranes shall be followed.

Note: Some OHC manufacturers require approval by the manufacturer or manufacturer's representative before lifting personnel.

5.5.4 One of the following options shall be implemented for lifts where the operator's view is restricted/obstructed:

5.5.4.1 One or more remote E-stops as required to ensure safe operations (see E-stop requirements in section 5.2.3.4); or

5.5.4.2 Handling procedures that minimize the risk, with LDEM approval.

5.5.5 Any time a final upper limit switch is activated, the cause shall be determined and resolved prior to further operations.

5.5.6 Personnel shall not be located under a suspended load except as specifically authorized by the OSHA-approved NASA Alternate Standard for Suspended Load Operations (see Appendix A).

Note: In accordance with Appendix A, a list of approved suspended load operations, a list of cranes/hoists used for suspended load operations, and copies of the associated hazard analyses must be provided to the OSHA Office of Federal Agency Programs via NASA Headquarters for distribution to the appropriate regional and area OSHA offices. Annual updates to the documentation will be provided as needed.

5.6 Labeling and Tagging

5.6.1 Per section 4.1.3, OHC labeling, and tagging shall comply with the applicable OSHA regulations, the requirements in this standard (note section 4.9) and VCS identified at the beginning of this section, and be based upon manufacturer recommendations and the following:

5.6.2 Overhead cranes shall have the directions of bridge and trolley travel marked on the cranes as follows:

a. The directions correspond to the directions on the operator controls.

b. The markings are visible from ground level.

Note: Directional markings may be omitted when the crane height or other conditions exist, such as reading the markings is difficult or impractical, subject to LDEM approval.

6. MOBILE CRANES AND DERRICKS

6.1 General

6.1.1 The requirements contained in section 6 are applicable to mobile cranes and derricks.

6.1.2 Per section 4.1.3, design, construction, testing, inspections, maintenance, and operations of mobile cranes and derricks shall comply with the applicable OSHA regulations, the requirements in this standard, ASME B30 series or DIN standards (ASME B30.5, ASME B30.6, ASME B30.22, DIN EN 13000) or equivalent as approved by the LDEM. Additionally, operation, testing, inspection, and maintenance of mobile cranes shall be based upon manufacturer recommendations.

6.2 Testing

Per section 4.1.3, tests shall comply with the applicable OSHA regulations, the requirements in this standard (note section 4.5), the VCS identified at the beginning of this section, be based upon manufacturer recommendations, and the following:

6.2.1 Proof Load Test

6.2.1.1 Proof load tests as stipulated in section 4.5 shall be performed with a mock load of 0.95 to 1.00 times the rated capacity of the mobile crane/derrick at the maximum and minimum working radius, except as noted in this section.

Note 1: Proof load tests for mobile cranes conducted by the manufacturer prior to delivery are acceptable if load test documentation is provided to verify the extent and thoroughness of the test.

Note 2: Testing at the minimum practical working radius that does not interfere with the crane/derrick structure is acceptable.

6.2.1.2 Loads shall be held for a time sufficient to verify no drift occurs.

6.2.1.3 Refer to section 12.3 for hook NDT/NDE requirements.

6.2.2 Periodic Load Test

6.2.2.1 Per section 4.5, a periodic load test shall be performed whenever a proof load test is required.

6.2.2.2 A periodic load test shall be performed on each mobile crane/derrick at least once every four years.

6.2.2.3 A periodic load test shall be performed after each boom change (when boom disassembly/assembly is required) if the mobile crane/derrick is to be used for NASA Critical lifts.

6.2.2.4 The periodic load test shall consist of the following:

a. With a mock load equal to 0.95 to 1.00 times the rated capacity at the minimum practical working radius:

(1) Hoist and lower the load at various speeds with the boom at the minimum radius.

Note: Testing at the minimum practical working radius that does not interfere with the crane/derrick structure is acceptable.

(2) Hold the load for a time sufficient to verify no drift occurs.

Note: The load should be held long enough to allow any dynamics to dampen out.

b. Check hoist brake system functionality by placing the load on the hook, hoisting up a few inches, holding the load for a time sufficient for the power-controlled lowering mechanism to bleed off fluid (verifies the functionality of the holding brake), then slowly lowering the load to the ground (verifies proper operation of the power-controlled lowering mechanism).

c. With a mock load not less than 0.50 times the rated capacity at a radius that will safely clear the outriggers (for telescopic boom cranes, use a boom length where all sections are partially extended, if possible):

(1) Perform boom hoisting and lowering.

(2) Check swing mechanism operation, pausing at each outrigger (when so equipped) for sufficient duration to verify no drift occurs.

d. With no load on the hook:

(1) Test all limit switches and E-stop switches.

(2) Test locking devices, boom angle indicators, and other safety devices when possible.

Note: It is not always possible to test safety devices (e.g., circuit breakers and thermal overload protection).

6.2.2.5 Other methods may be used to satisfy the periodic load test requirements, as approved by the LDEM.

6.2.2.6 Refer to section 12.3 for hook NDT/NDE requirements.

6.3 Operation

6.3.1 Per section 4.1.3, operations shall comply with the applicable OSHA regulations, the requirements in this standard (note section 4.7) the VCS identified at the beginning of this section, and be based upon manufacturer recommendations and the following:

6.3.2 Use of mobile cranes and derricks for load testing items such as slings, platforms, and lifting fixtures or to relieve a portion of the weight of a constrained load shall be subject to the following conditions:

a. The crane/derrick is specifically identified and documented for such use and approved by the LDEM.

b. The load is not to exceed 75 percent of the rated capacity of the crane.

c. The load is only applied vertically.

d. A load-measuring device is installed in the lifting assembly.

e. The boom angle is minimized as much as safely possible to prevent the boom from contacting the boom stops.

f. The boom shall be adequately restrained to prevent damage to the crane due to sudden unloading should the test article fail.

Note: Hydraulic boom cranes with sufficient damping to adequately restrain the boom (such as when equipped with double acting cylinders) do not need additional means of boom restraint, subject to approval by the LDEM.

g. When load testing an item freely suspended from the hook, the test weight is not to be lifted more than six inches above the floor/working surface or above the lowest reasonable height based on test item dimensions and configuration, subject to approval by the LDEM.

h. When load testing an item by pulling against a constrained object or one whose weight exceeds the desired test load, or when using a mobile crane/derrick to relieve a portion or all of the weight of a constrained load, the crane/derrick or lifting assembly (e.g., load positioning device) shall have sufficient fine motion capability to control movement of the load precisely to avoid crane overload or damage to the load.

Note: Using a mobile crane to load test items by pulling against an object whose weight exceeds the desired test load or for relieving a portion or all of the weight of a constrained load should be avoided if possible.

6.3.3 If it is determined that personnel must be lifted with a crane because conventional means of reaching a worksite such as aerial platform, ladder, stairs, or scaffold would be more hazardous, or if access is not possible because of structural design or worksite conditions, the requirements of 29 CFR 1926 shall be followed for lifting of personnel with a crane.

6.3.4 Personnel shall not be located under a suspended load except as specifically authorized by the OSHA-approved NASA Alternate Standard for Suspended Load Operations (see Appendix A).

Note: In accordance with Appendix A, a list of approved suspended load operations, a list of cranes/hoists used for suspended load operations, and copies of the associated *hazard analyses must be provided to the OSHA Office of Federal Agency Programs via NASA Headquarters for distribution to the appropriate regional and area OSHA offices. Annual updates to the documentation will be provided as needed.*

6.4 Personnel Training and Licensing

Per section 4.11, personnel training and licensing shall comply with the applicable OSHA regulations, the requirements in this standard, be based upon VCS, manufacturer recommendations and the following:

6.4.1 Regardless of the nature of the operation undertaken, all mobile crane operators shall conform to the training and certification requirements of OSHA 1926 Subpart CC.

7. HOISTS, WINCHES AND PORTABLE AUTOMOTIVE SERVICE EQUIPMENT

7.1 General

7.1.1 The requirements contained in this section are applicable to hoists and winches used for lifting and lowering a load but do not apply to winches used for horizontal pulls. These requirements apply to electric, air-powered, and manual hoists and winches including personnel access platform hoists/winches whose only purpose is to raise and lower a platform not carrying personnel. Additional requirements for hoists connected to platforms used to raise or lower personnel are contained in section 8, Hoist-Supported Personnel Lifting Devices. Requirements for portable automotive service equipment (PASE), such as shop cranes, etc., are included in this section when used for NASA Critical lift and non-critical NASA Technical lift operations.

7.1.2 There are no OSHA regulations pertaining specifically to hoists and winches and portable automotive service equipment for general industry. However, per section 4.1.3, design, construction, testing, inspection, maintenance, and operation of hoists and winches shall comply with the applicable OSHA regulations, the requirements in this standard and ASME B30 series standards (ASME B30.7, ASME B30.16, ASME B30.21 and ASME PASE) or equivalent as approved by the LDEM. Additionally, operation, testing, inspection, and maintenance of hoists and winches shall be based upon manufacturer recommendations.

7.1.3 Requirements for portable automotive service equipment shall comply with ASME PASE and manufacturers recommendations.

7.2 Design

Per section 4.1.3, design and construction shall comply with the applicable OSHA regulations, the requirements in this standard (note section 4.4), the VCS identified at the beginning of this section, be based upon manufacturer recommendations, and the following:

7.2.1 Mechanical

7.2.1.1 For powered hoists and winches:

a. Except as provided in section 7.2.1.1.b, hoists/winches used for NASA Critical lifts shall have one of the following:

(1) Two holding brakes, each capable of bringing a rated load to zero speed and holding it.

Note: A load brake may be considered a second holding brake provided it is capable of bringing a rated load to zero speed and holding it.

(2) A single holding brake in combination with a motor drive that automatically monitors brake functionality and motor torque.

b. Subject to LDEM approval, a hoist/winch with a single holding brake may be used for NASA Critical lifts when hoists/winches compliant with section 7.2.1.1.a (1) and (2) are not commercially available. To exercise this option, the following conditions shall be met:

(1) The responsible organization provides documented rationale to the LDEM.

Note: Rationale may include design and construction information, inspections, operations, maintenance and storage provisions, or other considerations.

(2) The LDEM determines there is no increase in risk.

c. Holding brake(s) shall be applied automatically when power to the brake is removed.

d. The brake design should provide for emergency load lowering.

e. Speed reduction from the motor to the drum on the hoist should be achieved by using gears enclosed in a gear case. If open gears are required, they shall be guarded with a provision for lubrication and inspection.

7.2.1.2 Worm gears shall not be used as a holding brake unless the lead angle prevents back driving.

Note: The braking properties of a worm gear tend to degrade with use; the design engineer should consider this in existing installations where the hoist is subject to heavy use or when purchasing new equipment.

7.2.1.3 Cast iron components shall not be used in the hoist or winch load path unless approved by the LDEM and the responsible organization.

Note: The material properties of cast iron allow catastrophic failure (brittle fracture), and it should not be considered as reliable as steel or cast steel. The engineer should consider this when selecting equipment and avoid the use of load bearing cast iron materials where possible.

7.2.2 Over-Travel Protection for Powered Hoist and Winches

7.2.2.1 Electric and air-powered hoists and winches used for NASA Critical lifts shall be equipped with dual upper limit switches.

7.2.2.2 For electric and air-powered hoists and winches used for NASA Critical lifts, a lower limit switch shall be provided to ensure no less than two wraps remain on the drum.

Note: Movement in the “raise” direction need not be inhibited in association with the lower limit switch function.

7.2.2.3 For air-powered hoists and winches equipped with dual upper limit switches, the final upper limit switch shall exhaust air from the hoist or winch, set the brakes, and require reset at the upper limit switch level.

7.2.2.4 Electric hoists and winches equipped with dual upper limit switches shall meet the following:

a. The initial upper limit switch precludes movement in the raise direction when the limit is reached.

Note: Movement in the "lower" direction need not be inhibited in association with the initial upper limit switch function.

b. The final upper limit switch is wired into the mainline circuit, hoist/winch power circuit, main contactor control circuit, or hoist/winch power contactor control circuit such that all hoist/winch motion is precluded when the limit is reached.

c. After a final upper limit switch has been activated, movement of the load requires action (resetting) at the final upper limit switch level.

Note: The hoist design should include a means of detecting limit switch failure and allow for safe inspection and repair. For example, a system may be equipped with two different colored annunciator lights, one for each limit switch. A reset button may be included so that when a final upper limit switch is tripped, the load can be lowered immediately. The reset button should be secured to prevent unauthorized or unintended use.

d. The initial upper limit switch is adjusted sufficiently low to preclude inadvertent actuation of the final upper limit switch if the hoist actuates the initial switch at full speed with no load. Similarly, the final upper limit is adjusted sufficiently low to ensure the hoist or winch will not two-block (or otherwise damage wire rope) if the hoist or winch actuates the final switch at full speed with no load.

Note: This requirement effectively lowers the usable hook height of the hoist.

7.2.2.5 Subject to LDEM approval, a hoist/winch with a single upper limit and no lower limit switch may be used for NASA Critical lifts when hoists/winches compliant with section 7.2 are not commercially available. To exercise this option, the following conditions shall be met:

a. The responsible organization provides documented rationale to the LDEM.

Note: Rationale may include design and construction information, inspections, operations, maintenance and storage provisions, or other considerations.

b. The LDEM determines there is no increase in risk.

7.2.2.6 Air-powered chain hoists may use a travel-limiting clutch in place of the final upper limit switch.

7.2.3 E-Stops for Powered Hoists and Winches

7.2.3.1 For electric hoists and winches, E-stops shall open the mainline contactor or the main circuit breaker.

Note: Emergency lighting and other personnel safety circuits may remain powered after remote E-stop actuation.

7.2.3.2 For air-powered hoists and winches, E-stops shall remove or isolate the pneumatic source from the hoist/winch.

Note: A dump valve is acceptable for the E-stop provided it also isolates the pneumatic source from the hoist/winch.

7.2.3.3 Operator E-stops shall be controlled by a red emergency stop button accessible to the operator. For portable powered hoists, an On/Off switch on the pendant controller may be used to disconnect from the main power source.

7.2.3.4 In cases where the operator's view is restricted/obstructed, the requirements of section 7.4.3 apply.

7.2.3.5 Remote E-stops shall be:

a. Located such that the E-stop operator(s) can clearly see the load and lift area(s).

b. Operated separately from and take precedence over the operator control circuit.

c. Operated by a standardized hand-held remote E-stop pendant that includes power and circuit continuity indications.

7.2.4 Portable automotive service equipment (PASE) design shall comply with ASME PASE requirements.

7.3 Testing

Per section 4.1.3, tests shall comply with the applicable OSHA regulations, the requirements in this standard (note section 4.5), the VCS identified at the beginning of this section, be based upon manufacturer recommendations, and the following:

7.3.1 Proof Load Test

7.3.1.1 Proof load tests as stipulated in section 4.5, for hoists and winches, shall be performed with a mock load of 1.10 to 1.25 times the rated capacity of the hoist/winch unless otherwise specified by the manufacturer.

Note: For personnel access platform hoists/winches, the attached platform may serve as part of the mock load.

7.3.1.2 Proof load tests for powered hoists and winches shall be conducted after installation at the site or facility in which they will be used, except as permitted in section 7.3.1.3.c.

7.3.1.3 Proof load tests at the site or facility are not required when replacing a powered hoist/winch on an existing mounting structure when all the following conditions are met:

a. The new hoist/winch is a replacement in kind (manufacturer, model, and load rating).

b. The existing mounting structure has been previously proof load tested in a manner that meets this standard.

c. The new hoist has been proof load tested by the manufacturer in a manner that meets this standard.

d. The responsible organization obtains LDEM approval.

7.3.1.4 Loads shall be held for a time sufficient to verify no drift occurs.

7.3.1.5 Refer to section 12.3 for hook NDT/NDE requirements.

7.3.1.6 Proof load testing of portable automotive service equipment shall comply with ASME PASE and manufacturers recommendations. Proof load test of shop cranes shall be performed with a mock load of 1.50 times the rated capacity.

Note: Manufacturers proof test can be accepted with proper documentation.

7.3.2 Periodic Load Test

7.3.2.1 Per section 4.5, a periodic load test shall be performed whenever a proof load test is required.

7.3.2.2 A periodic load test shall be performed on each hoist, winch, and PASE at least once every four years.

7.3.2.3 The periodic load test shall consist of the following:

a. With a mock load equal to 0.95 to 1.00 times the hoist/winch’s rated capacity or with the attached personnel access platform serving as the mock load (personnel access platform hoists/winches only), raise and lower the load at various speeds to ensure the hoist is functional under load.

Note: Consult the LDEM regarding appropriate range of travel.

b. Test the holding brakes in one of the following ways:

(1) Statically test each brake (under no load) to the design rated torque at the point of brake application.

Note: This method is preferred.

(2) Check each brake for its ability to hold a static mock load equal to 0.95 to 1.00 times the hoist's/winch's rated capacity.

Note 1: It must be possible to reactivate the out-of-circuit brake.

Note 2: This requirement applies to worm gears or load brakes used as holding brakes.

Note 3: For personnel access platform hoists/winches, the attached personnel access platform may serve as the mock load.

(3) Other methods as approved by the LDEM.

c. Test E-stop switches with no load on the hook (for personnel access platform hoists/winches, the personnel access platform may remain attached) by operating the E-stop and verifying all motions are precluded.

d. Test all limit switches with no load on the hook by operating the hoist/winch at slow speed into the limit switch and verifying the appropriate motion is precluded.

Note: For hoists/winches equipped with dual upper hoist limit switches, the final upper limit switch may be tested by manually tripping the switch and verifying all hoisting motion is precluded.

e. Test safety devices when possible.

Note: It is not always possible to test safety devices (e.g., circuit breakers and thermal overload protection).

7.3.2.4 Refer to section 12.3 for hook NDT/NDE requirements.

7.3.2.5 Periodic load testing of portable automotive service equipment shall comply with ASME PASE and manufacturers recommendations. Periodic load test of shop cranes shall be performed with a mock load of 0.95 to 1.00 times the rated capacity.

7.4 Operation

7.4.1 Per section 4.1.3, operations shall comply with the applicable OSHA regulations, the requirements in this standard (note section 4.7), the VCS identified at the beginning of this section, be based upon manufacturer recommendations and the following:

7.4.2 Methods and procedures should be developed for lowering a load in the event of hoist failure or other contingencies. These should be demonstrated and verified if practical.

7.4.3 One of the following options shall be implemented for lifts using powered hoists when the operator's view is restricted or obstructed:

a. One or more remote E-stops as required to ensure safe operations (see E-stop requirements in section 7.2.3).

b. Handling procedures that minimize the risk, with LDEM approval.

Note: Remote E-stops are the preferred method.

7.4.4 Hoists and winches shall not be used for lifting personnel unless specifically designed for such a purpose (see section 8).

Note: Some manufactures require approval by the manufacture or manufactures representatives before lifting personnel.

7.4.5 Use of hoist/winches for load testing items such as slings, platforms, and lifting fixtures or to relieve a portion of the weight of a constrained load shall be subject to the following conditions:

a. Hoist/winch is specifically identified and documented for such use and approved by the LDEM.

b. Hoist/winch is not used to load test items by pulling against the ground or against an otherwise fixed object.

c. Except in cases where the hoist/winch is used exclusively for load testing and related activities, the total load is not to exceed 50 percent of the rated capacity of the hoist/winch when performing the following:

(1) Load testing an item at a load greater than its periodic load test value as stipulated in this document.

Note: Refer to section 13.3 for additional restrictions on testing certain types of slings above their rated capacity.

(2) Load testing an item by pulling against an object whose weight exceeds the desired test load.

d. The total load is not to exceed 50 percent of the rated capacity of the hoist/winch when relieving a portion of the weight of a constrained load.

e. The load is only applied vertically.

f. A load measuring device is installed in the lifting assembly.

g. When load testing an item freely suspended from the hook, the test weight is not to be lifted more than six inches above the floor/working surface or above the lowest reasonable height based on test item dimensions and configuration, subject to approval by the LDEM.

h. The hoist/winch or lifting assembly (e.g., load positioning device) is to have sufficient fine motion capability to precisely control movement of the load so as to avoid hoist/winch overload or damage to the item when performing the following:

(1) Load testing an item by pulling against an object whose weight exceeds the desired test load.

(2) Relieving a portion or all of the weight of a constrained load.

i. When load testing an item by pulling against an object whose weight exceeds the desired test load, the weight of the object is within the rated capacity of the hoist/winch.

7.4.6 Personnel shall not be located under a suspended load except as specifically authorized by the OSHA-approved NASA Alternate Standard for Suspended Load Operations (see Appendix A).

Note: Per Appendix A, a list of approved suspended load operations, a list of cranes/hoists used for suspended load operations, and copies of the associated hazards analyses will be provided to the OSHA Office of Federal Agency Programs via NASA Headquarters for distribution to the appropriate regional and area OSHA offices. Annual updates to the documentation will be provided as needed.

7.5 Personnel Training and Licensing

7.5.1 Per section 4.11, personnel training and licensing shall comply with the applicable OSHA regulations, the requirements in this standard, be based upon VCS manufacturer recommendations, and the following.

7.5.2 Operators of manually operated hoists/winches, portable automotive service equipment and personnel access platform hoists shall be appropriately trained but do not have to be licensed unless required by Center policy or the LDEM.

8. HOIST-SUPPORTED PERSONNEL LIFTING DEVICES

8.1 General

8.1.1 The requirements contained in section 8 are applicable to hoist-supported personnel lifting devices. This section applies to devices specifically designed to lift and lower persons via hoist, including hoist-supported platforms where personnel occupy the platform during movement. This section does not apply to the following:

a. Personnel access platforms hoisted unoccupied to a position and anchored or restrained to a stationary structure before personnel occupy the platform.

b. Elevators covered by ASME A17.1, “Elevators, Dumbwaiters, Escalators, and Moving Walks”.

c. Mobile elevated work platforms (e.g., manlifts, aerial devices, scissors lifts, or other devices covered by ANSI/SAIA A92 series standards). See section 9, Mobile Elevated Work Platforms.

d. Platforms covered by ASME A120.1, “Safety Requirements for Powered Platforms and Traveling Ladders and Gantries for Building Maintenance”.

e. Hoist-supported personnel lifting devices that are covered by ASME B30.23 and ANSI B56.1.

8.1.2 Per section 4.1.3, hoist- supported personnel lifting devices shall meet the applicable OSHA regulations and applicable VCS for design, construction, testing, inspection, maintenance, and operation that apply to the LDE of which they are composed, in addition to the requirements in this standard. Additionally, operation, testing, inspection, and maintenance of hoist-supported personnel lifting devices shall be based upon manufacturer recommendations for the LDE of which they are composed.

8.1.3 Classify lifts per section 4.2 and the following:

8.1.4 Lifting of personnel using hoist-supported personnel lifting device shall be classified as a NASA Critical lift.

8.2 Design

8.2.1 Per section 4.1.3, hoist-supported personnel lifting devices shall comply with the applicable OSHA regulations and the VCS identified at the beginning of this section for the LDE of which they are composed, the requirements of this standard (note sections 4.4 and 7.2), and be based upon manufacturer recommendations and the following:

8.2.2 Hoist-supported personnel lifting devices shall have at least one of the following:

a. Two independent support systems consisting of two separate hoists such that the failure of one hoist, its reeving system, or other component will not cause the stability of the personnel lifting device to be lost or prohibit its movement to a safe location.

b. A single support system with two or more holding brakes and additional design factors for the hoist and other load bearing components as approved by the LDEM.

c. Other methods/attributes as approved by the LDEM.

8.2.3 Hoist-supported personnel lifting devices shall allow for safe egress of personnel being lifted or for emergency lowering to the ground level or other safe location.

8.2.4 Hoist-supported personnel lifting devices shall be equipped with an E-stop device within reach of the person controlling movement of the device that deenergizes the powered systems and stops the movement of the device.

Note: An additional E-stop separate from normal operating controls should be considered for personnel at ground level or on a fixed structure to enhance operational safety.

8.2.5 All directional controls shall be designed so they automatically return to a neutral position when released. Neutral position of controls shall bring the unit to a safe stop and hold the unit in that position until commanded to move to another position.

8.3 Testing

Per section 4.1.3, tests of hoist-supported personnel lifting devices shall comply with the applicable OSHA regulations and VCS for the LDE of which they are composed, the requirements in this standard (note section 4.5), and be based upon manufacturer recommendations and the following:

8.3.1 Proof Load Test

8.3.1.1 Proof load tests as stipulated in section 4.5 shall be performed with a mock load of 1.45 to 1.50 times the rated capacity of the hoist-supported personnel lifting devices.

8.3.1.2 Loads shall be held for a time sufficient to verify no drift occurs.

8.3.1.3 Refer to section 12.3 for hook NDT/NDE requirements.

8.3.2 Periodic Load Test

8.3.2.1 Per section 4.5, a periodic load test shall be performed whenever a proof load test is required.

8.3.2.2 A periodic load test shall be performed on each hoist-supported personnel lifting device at least once every year with a load equal to 0.95 to 1.00 times the device’s rated load.

8.3.2.3 The periodic load test shall consist of the following:

a. Raise and lower the load at various speeds with a mock load equal to 0.95 to 1.00 times the personnel lifting device's rated capacity to ensure the hoist(s) is functional under load.

Note: Consult the LDEM regarding appropriate range of travel.

b. Test the holding brakes in one of the following ways:

(1) Statically test each brake (under no load) to the design rated torque at the point of brake application.

Note: This method is preferred.

(2) Check each brake for its ability to hold a static mock load equal to 0.95 to 1.00 times the rated capacity of the personnel lifting device.

Note 1: It must be possible to reactivate the out-of-circuit brake.

Note 2: This requirement applies to worm gears or load brakes used as holding brakes.

(3) Other methods as approved by the LDEM.

c. Test E-stop switches with no load on the personnel lifting device by operating the E- stop and verifying all motions are precluded.

d. Test all limit switches with no load on the device by operating the device at slow speed into the limit switch and verifying the appropriate motion is precluded.

Note: The final upper limit switch may be tested by manually tripping the switch and verifying all hoist motion is precluded.

e. Test safety devices when possible.

Note: It is not always possible to test safety devices (e.g., circuit breakers and thermal overload protection).

8.3.2.4 Refer to section 12.3 for hook NDT/NDE requirements.

8.4 Inspection

Per section 4.1.3, inspections of hoist-supported personnel lifting devices shall comply with the applicable OSHA regulations and VCS for the LDE of which they are composed, the requirements in this standard (note section 4.6), and be based upon manufacturer recommendations and the following:

8.4.1 Daily Inspection

8.4.1.1 Each day a hoist-supported personnel lifting device is used, the following inspections shall be performed prior to using the device:

a. Check for defects such as cracked welds, damaged control cables, loose wire connections, and wheel or roller damage.

b. Check operating mechanisms, control mechanisms, and guard rails for proper function.

c. Check hose and fittings, tanks, valves, drain pumps, gear casings, and other components of fluid systems for deterioration and leaks.

d. Without disassembling, inspect all functional operating and control mechanisms for excessive wear and contamination by excessive lubricants or foreign matter.

8.4.2 Periodic Inspection

8.4.2.1 At least once per year, the following inspections shall be performed on all hoist-supported personnel lifting devices, in addition to a daily inspection:

a. Check for deformed, cracked, or corroded members and welds and loose bolts or rivets in the personnel lift structure.

b. Check for cracked or worn sheaves and drums.

c. Check for excessive wear or cracks in pins, bearings, shafts, gears, followers, and locking and clamping devices.

8.5 Operation

8.5.1 Per section 4.1.3, operation of hoist-supported personnel lifting devices shall comply with the applicable OSHA regulations and VCS for the LDE of which they are composed, the requirements in this standard (note section 4.7), and be based upon manufacturer recommendations and the following:

8.5.2 The operator shall perform a pre-operational check of the controls. If controls do not operate properly, repairs and adjustments shall be made before operations begin.

8.5.3 Materials and equipment shall be secured while the platform is lifted.

8.5.4 Prior to an operation, hoist-supported personnel lifting device operators shall test the communication system. If communications are disrupted, all operations shall be stopped until communication is reestablished.

8.5.5 Personnel shall keep all parts of the body, tools, and equipment inside the platform periphery during raising, lowering, and traveling operations.

9. MOBILE ELEVATED WORK PLATFORMS

9.1 General

9.1.1 The requirements contained in section 9 are applicable to mobile elevated work platforms, including vehicle mounted elevating and rotating aerial devices.

9.1.2 Per section 4.1.3, design, construction, testing, inspections, maintenance, and operations of mobile aerial platforms shall comply with the applicable OSHA regulations, the requirements in this standard, VCS, and ANSI/SAIA A92 series standards (A92.2, A92.20, A92.22, A92.24) or equivalent as approved by the LDEM. Additionally, operation, testing, inspection, and maintenance of mobile aerial platforms shall be based upon manufacturer recommendations.

9.2 Testing

Per section 4.1.3, tests shall comply with the applicable OSHA regulations, the requirements in this standard (note section 4.5), the VCS identified at the beginning of this section, be based upon manufacturer recommendations, and the following:

9.2.1 Proof Load Test

9.2.1.1 Proof load tests as stipulated in section 4.5 shall be performed per manufacturer instructions and the applicable VCS.

9.2.2 Periodic Load Test

9.2.2.1 Per section 4.5, a periodic load test shall be performed whenever a proof load test is required.

9.2.2.2 A periodic load test shall be performed on each mobile elevated work platform at least once a year.

9.2.2.3 The periodic load test shall consist of the following:

a. Hold a mock load equal to 0.95 to 1.00 times the device's rated capacity (at maximum boom radius, when applicable) for a sufficient duration to verify drift does not exceed that specified by the responsible organization.

Note: Equipment application, manufacturer recommendations, and engineering analyses should be considered when determining acceptable amount of drift.

b. Test all functions in an unloaded condition, including operation of limit switches and tilt alarm/shutoff.

Note: Where possible, use the ground control station. When it is necessary to use the platform control station, operate close to ground level.

9.3 Personnel Training and Licensing

9.3.1 Per section 4.11, personnel training and licensing shall comply with the applicable OSHA regulations, the requirements in this standard, the VCS identified at the beginning of this section, be based upon manufacturer recommendations, and the following:

9.3.2 Per section 4.11, manually operated mobile platform operators shall be appropriately trained, but do not have to be licensed unless required by Center policy or the LDEM. There are no additional requirements specific to mobile elevated work platforms in this section.

10. HIGH LIFT INDUSTRIAL TRUCKS

10.1 General

10.1.1 The requirements contained in section 10 is applicable to industrial trucks equipped with an elevating mechanism designed to permit levels of vertical movement including, but not limited to, forklift trucks, platform trucks, picker trucks, reach trucks, and high lift pallet jacks.

Note: This section is not applicable to industrial trucks equipped with an elevating mechanism designed to raise the load only sufficiently to permit horizontal movement including, but not limited to, low lift pallet jacks.

10.1.2 Per section 4.1.3, design, construction, testing, inspections, maintenance, and operations of high lift industrial trucks and their attachments shall comply with the applicable OSHA regulations, the requirements in this standard, and the applicable ANSI/ITSDF standards (ANSI/ITSDF B56.1, B56.6, B56.10, or B56.14) or equivalent as approved by the LDEM. Additionally, operation, testing, inspection, and maintenance of high lift industrial trucks and their attachments shall be based upon manufacturer recommendations.

10.2 Safety Hazard Analysis

10.2.1 Perform a safety hazard analysis on NASA Critical or custom-built equipment as required in section 4.3, except with documented authorization by the LDEM per section 4.3.1 and the following.

10.2.2 Centers shall assess when powered industrial trucks are used in hazardous locations (29 CFR 1910.178) and when handling explosive and energetic materials, as required in section 4.7.

10.3 Testing

Per section 4.1.3, tests shall comply with the applicable OSHA regulations, the requirements in this standard (note section 4.5), the VCS identified at the beginning of this section, be based upon manufacturer recommendations and the following:

10.3.1 Proof Load Test

10.3.1.1 Proof load tests as stipulated in section 4.5 shall be performed with a mock load equal to 0.95 to 1.00 times rated capacity. The proof load test for industrial trucks and their attachments shall consist of a periodic load test as specified in section 10.3.2.

10.3.2 Periodic Load Test

10.3.2.1 Per section 4.5, performance of a periodic load test satisfies the proof load test requirement for industrial trucks and their attachments.

10.3.2.2 A periodic load test shall have been performed on an industrial truck and its attachments within one year prior to their use for a NASA Critical lift operation.

10.3.2.3 For industrial trucks, the periodic load test shall be performed with a mock load equal to 0.95 to 1.00 times the industrial truck's rated capacity as follows:

a. Perform all functions, including tilt operation. Ensure the load is secured and will not move during tilting operations.

b. Hold the load for a sufficient duration to verify drift does not exceed that specified by the responsible organization.

Note: Equipment application, manufacturer recommendations, and engineering analyses should be considered when determining acceptable amount of drift.

10.3.2.4 For attachments, the periodic load test shall be performed with a mock load equal to 0.95 to 1.00 times the lesser of the following:

a. The rated capacity of the attachment.

Note: If load testing an attachment to its rated capacity, ensure that the industrial truck or test fixture used for load testing can safely handle the load. The capacity of the attachment may exceed the capacity of the industrial truck and attachment combination. Always follow the industrial truck name capacity and/or data plate.

b. The rated capacity of the industrial truck and attachment combination.

Note: For attachments used on multiple industrial trucks, test the industrial truck and attachment combination with the highest rated capacity.

10.3.2.5 For attachments, the load shall be held for a minimum of 30 seconds or for a duration as determined by the manufacturer.

10.4 Inspection

10.4.1 Per section 4.1.3, inspections shall comply with the applicable OSHA regulations, the VCS specified at the beginning of this section, requirements in this standard (note section 4.6), be based upon manufacturer recommendations, and the following:

10.4.2 At least once per year, the following items, plus any others recommended by the manufacturer, shall be visually inspected for excessive deterioration, wear, signs of malfunctions, or other potential problems or discrepancies that may affect the safe operation of the industrial truck:

a. Air intakes and/or filter.

b. Attachments and attachment plates.

c. Axle stops.

d. Brakes.

e. Chains and cables.

f. Controls.

g. Electrical equipment.

h. Fluid levels and lines.

i. Forks.

j. Frame members.

k. Hydraulic system.

l. Lift and tilt mechanisms.

m. Lights.

n. Motors.

o. Manufacturing plates, tags, decals (in legible condition).

p. Safe operating features or devices designed and approved for hazardous area operations.

q. Motors.

r. Hydraulic system.

s. Electrical equipment.

t. Attachments.

u. Lift and tilt mechanisms.

v. Chains and cables.

w. Brakes.

x. Steering mechanism.

y. Warning and safety devices.

z. Welds.

aa. Wheels and Tires

10.5 Operation

10.5.1 Per section 4.1.3, operations shall comply with the applicable OSHA regulations, the requirements in this standard (note section 4.7), the VCS identified at the beginning of this section, be based upon manufacturer recommendations, and the following:

10.5.2 Powered industrial truck operations, specifically forklift-lifts and forklift-transport shall require:

a. Certified/licensed PIT operators

b. PIT Operators shall have a physical examination in accordance with ANSI ITSDF B56.1/B56.6.

c. Pre-use inspections

d. Verify forklift capacity to expected load.

e. Operators have spatial awareness of the operational surroundings throughout the path of travel.

f. Adhere to laws/policies for roadway, flightline, hangars or other paths of travel

g. Operators ensure the loads is properly secured for transport.

h. Spotters per section 10.5.3 and center policy (e.g., aircraft proximity).

10.5.3 Vertical and horizontal moving access doors and gates should be in the fully open position or opening should exceed the maximum raised height and width of the powered industrial truck (PIT) and load, prior to traveling through the access door or gate opening.

10.5.4 In cases where the moving door or gate is not in the full and open position, use of an identified spotter or alternative method of controls that provide an equivalent level of safety as determined by the center LDEM shall be utilized.

Note: Examples for operating with less than full and open doors and gates include but not limited to inclement weather, large door or gate openings relative to PIT/load size, specialized painting and processing facilities, clean room air-locks, etc.

10.6 Personnel Training and Licensing

10.6.1 Per section 4.11, personnel training and licensing shall comply with the applicable OSHA regulations, the requirements in this standard, be based upon the VCS identified at the beginning of this section, manufacturer recommendations, and the following:

10.6.2 Manually propelled industrial truck operators shall be appropriately trained and authorized but do not have to be licensed unless required by Center policy or the LDEM.

10.6.3 In addition to the requirements outlined in section 4.11.2.1, a documented refresher training including performance evaluation of powered industrial truck operators shall be performed in accordance with OSHA 1910.178 when:

a. The operator has been observed to operate the vehicle in an unsafe manner.

b. The operator has been involved in an accident or near-miss incident.

c. The operator has received an evaluation that reveals that the operator is not operating the truck safely.

d. The operator is assigned to drive a different type of truck; or

e. A condition in the workplace changes in a manner that could affect safe operation of the truck.

10.6.4 Powered industrial truck training program shall include the use of identified spotter(s) referenced in section 10.5.1.

11. JACKS

11.1 General

11.1.1 The requirements contained in section 11 apply to jacks used for NASA Critical lifts and jacks used for non-critical lifts at the discretion of the LDEM.

Note 1: Jacks used for non-critical lifts must comply with OSHA and other regulatory requirements and should be operated, tested, and maintained in accordance with VCS and manufacturer instructions.

Note 2: Jacks used as portions of fixtures whose sole purpose is to render ineffective items, such as wheels or casters, through minimal lifting are not considered to be lifting hardware and are not subject to the requirements of section 11.

Note 3: Horizontal jacks, equipment presses, non-portable jacks, and leveling devices are not considered NASA lifting devices/equipment and are excluded from the requirements of this standard.

11.1.2 Per section 4.1.3, design, construction, testing, inspection, maintenance, and operation of NASA Critical lift jacks shall comply with the applicable OSHA regulations, the requirements in this standard, and the ASME B30 series standards (ASME B30.1) or equivalent as approved by the LDEM. Additionally, operation, testing, inspection, and maintenance of NASA Critical lift jacks shall be based upon manufacturer recommendations.

11.2 Testing

Per section 4.1.3, tests shall comply with the applicable OSHA regulations, the requirements in this standard (note section 4.5), the VCS identified at the beginning of this section, be based upon manufacturer recommendations, and the following:

11.2.1 Proof Load Test

11.2.1.1 Proof load tests as stipulated in section 4.5 shall be performed. The proof load test shall consist of a periodic load test as specified in section 11.2.2.

Note: Proof load tests conducted by the manufacturer prior to delivery are acceptable if load test documentation is provided to verify the extent and thoroughness of the test.

11.2.2 Periodic Load Test

11.2.2.1 Per section 4.5, performance of a periodic load test satisfies the proof load test requirement for jacks.

12. HOOKS

12.1 General

12.1.1 The requirements contained in section 12 is applicable to hooks used on LDE.

12.1.2 Per section 4.1.3, design, construction, testing, inspections, maintenance, and operations using hooks shall comply with the applicable OSHA regulations, the requirements in this standard, and ASME B30 series standards (ASME B30.10) or equivalent as approved by the LDEM. Additionally, operation, testing, inspection, and maintenance of hooks shall be based upon manufacturer recommendations.

12.2 Testing

12.2.1 OSHA regulations pertaining specifically to hooks are addressed in various standards that cover the associated equipment or activities in which they are used, such as: 29 CFR 1910.179, 1910.180, 1910.181, 1910.184, 1926 Subpart N, Subpart CC, and others.

12.2.2 Per section 4.1.3, tests shall comply with the applicable OSHA regulations, the requirements in this standard (note section 4.5), the VCS identified at the beginning of this section, be based upon manufacturer recommendations, and the following:

12.2.3 Hooks shall be required to pass the tests of the equipment of which they are a part.

12.2.4 All hooks shall be proof tested in accordance with ASME B30.10 and per manufacturers' recommendations. For a hook with multiple prongs, the proof load shall be shared equally amongst all prongs on the hook unless designed for unbalanced loading.

12.3 Inspection

12.3.1 Per section 4.1.3, inspections shall comply with the applicable OSHA regulations, the requirements in this standard (note section 4.6), the VCS identified at the beginning of this section, be based upon manufacturer recommendations, and the following:

12.3.2 Hooks shall be inspected during the inspections of the equipment of which they are a part.

12.3.3 Hooks on overhead cranes, mobile cranes, and NASA Critical lift hoists shall be inspected using surface NDT/NDE method in addition to visual immediately after all proof load and periodic load tests prior to further use of the hook.

12.3.4 Periodic hook surface NDT/NDE intervals may be extended by no more than 90 days from the original expiration date due to programmatic or institutional needs, subject to LDEM approval. To extend the surface NDT/NDE interval, the following conditions shall be met:

a. The responsible organization provides documented rationale to the LDEM.

b. The LDEM determines there is no increase in risk.

12.3.5 Volumetric NDT/NDE shall be conducted on new hooks at the discretion of the LDEM and the responsible organization.

12.4 Maintenance

12.4.1 Per section 4.1.3, maintenance shall comply with the applicable OSHA regulations, the requirements in this standard (note section 4.8), the VCS identified at the beginning of this section, be based upon manufacturer recommendations and the following:

12.4.2 After being repaired, hooks shall be proof load tested using the associated lifting device/equipment proof load value.

Note: Minor grinding of surface level cracks does not require a proof load test if repairs are made following an approved OEM procedure.

12.5 Labeling and Tagging

12.5.1 Per section 4.1.3, labeling and tagging shall comply with the applicable OSHA regulations, the requirements in this standard (note section 4.9) the VCS identified at the beginning of this section, be based upon manufacturer recommendations, and the following:

12.5.2 Per section 4.9, hooks that are part of other LDE do not need separate marking, labeling, and tagging.

13. SLINGS, RIGGING HARDWARE, BELOW-THE-HOOK LIFTING DEVICES, LOAD POSITIONING DEVICES, AND LOAD MEASURING DEVICES

13.1 General

13.1.1 The requirements contained in section 13 are applicable to slings, rigging hardware, and below-the-hook lifting devices, including slings constructed of wire rope, alloy steel chain, metal mesh, synthetic rope, synthetic web, synthetic round slings, and associated rigging hardware, such as shackles, D-rings, turnbuckles, eyebolts, load positioning, and load measuring devices. Load positioning devices (e.g., Hydra Sets®) are self-contained links between the hoist and the load, which provide accurate vertical positioning capability.

13.1.2 Per section 4.1.3, design, construction, testing, inspections, maintenance, and operations of slings shall comply with the applicable OSHA regulations, the requirements in this standard, and ASME B30 series standards (ASME B30.9) or equivalent as approved by the LDEM. Additionally, operation, testing, inspection, and maintenance of slings shall be based upon manufacturer recommendations.

13.1.3 There are no OSHA regulations specifically addressing rigging hardware, below-the-hook lifting devices, load positioning, or load measuring devices. However, per section 4.1.3, design, construction, testing, inspections, maintenance, and operations of these items shall comply with the requirements in this standard and the applicable ASME B30 series standards (B30.20 and ASME BTH-1 for below-the-hook lifting devices, and B30.26 for rigging hardware) or equivalent as approved by the LDEM. Additionally, operation, testing, inspection, and maintenance of rigging hardware, below-the-hook lifting devices, load positioning and load measuring devices shall be based upon manufacturer recommendations.

13.2 Design

Per section 4.1.3, design and construction shall comply with the applicable OSHA regulations, the requirements in this standard (note section 4.4), and be based upon manufacturer recommendations and the following:

13.2.1 All surfaces of below-the-hook lifting devices not painted, lubricated, or coated with strippable vinyl should be corrosion-protected.

13.2.2 Pneumatically-controlled load positioning devices shall have the following:

a. A fail-safe check valve on the pneumatic feed line that “locks up” the device in the event of a drop or loss of pneumatic control system pressure.

b. A fast-acting safety shutoff valve downstream of the load regulator to provide positive control of the device when no motion is desired.

13.2.3 Only accepted industry standard materials and techniques shall be used in slings and rigging hardware (natural rope, knots, and wire rope clips are not considered industry standard materials and techniques).

13.3 Testing

13.3.1 General

13.3.1.1 Per section 4.1.3, tests shall comply with the applicable OSHA regulations, requirements in this standard (note section 4.5) and the VCS identified at the beginning of this section, be based upon manufacturer recommendations, and the following:

13.3.1.2 When slings and below-the-hook lifting devices are composed of more than one sling or rigging hardware component:

a. The components shall be tested as an assembly, individually, or both, as dictated by worst case stress and stability considerations.

b. When testing as an assembly, the load test value shall be based upon the rated load for the assembly.

c. When testing as individual components:

(1) Rigging hardware periodic load test intervals may be in accordance with the rigging hardware requirements of this section.

(2) Individual sling and rigging hardware component load test values may be based upon the component rated load within the assembly rather than the individual component rated load.

Note: OSHA regulations in 29 CFR 1910.184, Slings, and formal OSHA Letters of Interpretation prohibit loading by the user beyond rated load for alloy steel chain, wire rope, metal mesh, synthetic rope, synthetic round slings, and synthetic web except as described above. If Center personnel design an assembly consisting of lifting hardware produced by one or more manufacturers and build that hardware assembly, the manufacturer of each piece of hardware remains its manufacturer for purposes of determining testing.

13.3.1.3 Turnbuckles should be load tested at the fully open position as a minimum.

Note: It is recommended that turnbuckles be tested at the open, closed, and midway positions.

13.3.1.4 For all load tests, the load should be held long enough for dynamics to be dampened out or for a duration as determined by the manufacturer.

13.3.1.5 Refer to section 12.3 for hook NDT/NDE requirements.

13.3.2 Proof Load Test

13.3.2.1 Proof load tests of NASA Critical LDE as stipulated in section 4.5 for LDE in this section shall be performed with a mock load weight value of 1.95 to 2.00 times the rated capacity, except as specified in this section.

Note 1: High capacity rigging hardware may have a reduced load test factor based on manufacturer requirements.

Note 2: Proof load test requirements for below-the-hook lifting devices are noted below in 13.3.2.6.

13.3.2.2 Proof load tests of NASA non-critical LDE as stipulated in section 4.5 shall be performed with a mock load weight value in accordance with the specific ASME load testing, except as specified in this section.

Note: Batch or production lot testing of sample slings and rigging hardware does not meet the proof load test requirements in this section.

13.3.2.3 Proof load tests for alloy steel chain, wire rope, metal mesh, synthetic rope, synthetic round slings, and synthetic web slings can only be performed by the manufacturer or the sling's user with manufacturer's written permission and procedures with LDEM concurrence.

13.3.2.4 For lifting interfaces, such as eyebolts, pad eyes, D-rings, lifting lugs, etc., permanently attached to the load (i.e., they will not be removed from the load prior to its use), analysis may be substituted to verify the integrity of the interface, subject to LDEM approval. To exercise this option, the following conditions shall be met:

a. The responsible organization provides documented rationale to the LDEM.

Note: Rationale should include design and construction information, inspections, operations, maintenance considerations, storage provisions, and other considerations.

b. The LDEM determines there is no increase in risk.

13.3.2.5 For below-the-hook lifting devices the proof load test shall be as specified in the applicable ASME standard (B30.20 or B30.26), and for components or subcomponents of the device, as specified in the respective ASME B30 standard or as recommended by the designer with concurrence from the LDEM.

13.3.2.6 For load positioning devices, the proof load test shall consist of holding a mock load of 1.20 to 1.25 times the rated capacity or as recommended by the designer with concurrence from the LDEM. For load measuring devices, the proof load test shall consist of a periodic load test as specified in section 13.3.3.4.

13.3.3 Periodic Load Test

13.3.3.1 Performance of a proof load test satisfies the periodic load test requirement for slings, rigging hardware, load positioning, and load measuring devices.

13.3.3.2 The periodic load test for slings, rigging hardware, below-the-hook lifting devices, load positioning, and load measuring devices shall be conducted with a mock load equal to 0.95 to 1.00 times the sling/rigging hardware/device rated capacity.

13.3.3.3 For load positioning devices, the periodic load test shall consist of the following:

a. Operate the unit to the mid-travel position. Inspect unit for hydraulic leaks, structural damage, scoring, and corrosion of the piston rod.

b. Hold the load for a sufficient duration to verify drift does not exceed that specified by the responsible organization.

Note: Equipment application, manufacturer recommendations, and engineering analyses should be considered when determining acceptable amount of drift.

13.3.3.4 When load positioning device seals are replaced, a load test shall be performed.

13.3.3.5 For load measuring devices, the periodic load test shall include an annual calibration of the unit per ASME B30.26.

13.3.3.6 A periodic load test shall be performed on slings and below-the-hook lifting devices within one year prior to its use in a NASA Critical lift operation unless designated as a non-load test sling or non-load test below-the-hook lifting device.

13.3.3.7 A periodic load test shall be performed on rigging hardware within one year prior to its use in a NASA Critical lift operation unless one of the following applies:

a. It is designated as non-load test rigging hardware.

b. It is a lifting interface that is permanently attached to the load such as an eyebolt, D- ring, lifting lug, or proved by analysis.

13.3.4 Non-Load Test Slings, Rigging Hardware, and Below-the-Hook Lifting Devices

13.3.4.1 Slings, rigging hardware, and below-the-hook lifting devices may be designated as non- load test slings/rigging hardware/below-the-hook lifting devices due to considerations such as usage, inspection and testing history, and potential for test induced damage, subject to LDEM approval. Non-load test slings/rigging hardware/below-the-hook lifting devices are not subject to periodic load testing requirements. To exercise this option, the following conditions shall be met:

a. The responsible organization provides documented rationale to the LDEM.

Note: Rationale may include design and construction information, inspections, operations, maintenance history, storage provisions, or other considerations.

b. The LDEM determines there is no increase in risk.

13.3.4.2 The responsible organization shall label and tag non-load test slings/rigging hardware per section 13.7.

13.4 Inspection

13.4.1 Per section 4.1.3, inspections shall comply with the applicable OSHA regulations, the requirements in this standard (note section 4.6), and be based upon manufacturer recommendations and the following:

13.4.2 Prior to use of a load positioning device each day, the following inspections shall be performed:

a. Check operating and control mechanisms for proper function.

b. Without disassembly, visually inspect all functional operating and control mechanisms for excessive wear and contamination by excessive lubricants or foreign matter.

c. Visually inspect for corrosion, damage, cracks, and deformities.

d. Inspect hydraulic system for deterioration and leakage.

e. Check for loose hardware.

13.4.3 For load positioning devices, the inspections described in this section shall form part of the frequent and periodic inspections in addition to the inspections in the referenced VCS.

13.4.4 Prior to use each day, the following inspections shall be performed on below-the-hook lifting devices:

a. Check for defects such as cracks, deformations, gouges, galling, kinks, crushed areas, and corrosion.

b. Check for proper configuration.

13.4.5 All slings, rigging hardware, and below-the-hook lifting devices rejected during inspection shall be marked and separated from accepted slings/rigging hardware/below-the-hook lifting devices.

Note: Refer to section 13.6 for rejected sling and rigging hardware disposition.

13.5 Operation

13.5.1 Per section 4.1.3, operations shall comply with the applicable OSHA regulations, the requirements in this standard (note section 4.7), the VCS identified at the beginning of this section, be based upon manufacturer recommendations, and the following:

13.5.2 For pneumatically-controlled load positioning devices, a procedure shall be developed and implemented to ensure the fail-safe check valve is set to an appropriate sensitivity.

Note: Normally, the valve is set at the mid-point of its range, which is satisfactory for most operations. However, depending on the specifics of the lift, it may be necessary to reset the valve using a mock load as outlined in the manufacturer recommended procedures.

13.5.3 Synthetic rope slings may be used for NASA Critical lifts with LDEM's approval. Synthetic rope slings used in NASA Critical lifts shall be COTS and manufactured, tested, and inspected in accordance with ASME B30.9, OSHA 1910.184, and WSTDA.

Note: This requirement only applies to synthetic rope slings. It does not apply to other slings made of synthetic fibers such as synthetic round slings and synthetic web slings.

13.5.4 Slings, rigging hardware, and below-the-hook lifting devices shall not be loaded beyond the rated load except for required testing performed as outlined in section 13.3.

13.6 Maintenance

13.6.1 Per section 4.1.3, maintenance shall comply with the applicable OSHA regulations, the requirements in this standard (note section 4.8), the VCS identified at the beginning of this section, be based upon manufacturer recommendations, and the following:

13.6.2 A designated person shall perform an engineering assessment on rejected slings, rigging hardware, and below-the-hook lifting devices to determine whether the sling and rigging hardware is repairable.

13.6.3 Non-repairable slings and rigging hardware shall be destroyed or disposed of as soon as possible to avoid unintentional use.

13.7 Labeling and Tagging

13.7.1 Per section 4.1.3, labeling and tagging shall comply with the applicable OSHA regulations, the requirements in this standard (note section 4.9), and be based upon manufacturer recommendations and the following:

13.7.2 Non-load test slings, rigging hardware, and below-the-hook lifting devices shall be marked conspicuously as such.

13.7.3 Following each periodic inspection of non-load test sling/rigging hardware/below-the-hook lifting devices, a durable tag shall be affixed to the sling/rigging hardware/below-the-hook lifting device stating the next required periodic inspection date or inspection expiration date.

13.7.4 When slings and below-the-hook lifting devices are composed of an assembly of more than one sling or rigging hardware components, all load-bearing sling and rigging hardware components shall be traceable to the assembly.

Note: This may be accomplished by clearly marking/coding or tethering all components of the assembly, through configuration control, or other procedures.

13.8 Personnel Training and Licensing

13.8.1 Per section 4.11, personnel training and licensing shall comply with the applicable OSHA regulations, the requirements in this standard, the VCS identified at the beginning of this section, be based upon manufacturer recommendations, and the following:

13.8.2 13.8.1 Load positioning device and load measuring device operators shall be appropriately trained but do not have to be licensed unless required by Center policy or the LDEM.

APPENDIX A. NASA Alternate Standard for Suspended Load Operations

Note: In the following appendix, the term "will" is used rather than the term "shall" to indicate mandatory requirements. Terminology is not being updated because OSHA has approved the text with imperatives indicated by "will" as written.

Figure 1-A OSHA Alternate Standard on Suspended Loads Revalidation Letter

U.S. Department of Labor

Assistant Secretary for
Occupational Safety and Health
Washington, D.C. 20210

MAR 28 2002

Mr. James D. Lloyd
Director, Safety and Risk Management Division
Office of Safety and Mission Assurance
National Aeronautics and Space Administration
Headquarters Code QS
Washington, D.C. 20546-0001

Dear Mr. Lloyd:

Thank you for your December 20, 2001 letter to the Occupational Safety and Health Administration (OSHA). We apologize for the delay in our response. Due to the October 2001 closing of the Brentwood postal facility in Washington, D.C. and the subsequent sanitizing treatment of the mail, your correspondence was not received until February 4, 2002. A letter dated February 25, 2002 amended your December 20 letter.

You requested that OSHA review and revalidate the revised version of the National Aeronautics and Space Administration's (NASA's) Alternate Standard for Suspended Load Operations. OSHA originally approved this alternate standard on July 15, 1991, in accordance with the requirements of 29 CFR 1960.17. (See enclosed letter.) The approval was based on OSHA's determination that the alternate standard provides equivalent protection as would compliance with the following standards in specifically identified operations:

- 1910.179(n)(3)(vi) The employer shall require that the operator avoid carrying loads over people.
- 1910.180(h)(3)(vi) The operator should avoid carrying loads over people.
- 1910.180(h)(4)(ii) No person should be permitted to pass under a load on the hook.

2

The alternate standard is currently a part of NASA's Safety Standard for Lifting Devices and Equipment (NSS/GO-1740.9B). NASA is in the approval process for updating and issuing the safety standard in a new format as the Standard for Lifting Devices and Equipment (NASA-STD-8719.9). NASA intends to include a revised version of the alternate standard on suspended loads as part of NASA-STD-8719.9. The minor revisions NASA proposes to the existing alternate standard are:

- Renumbering of the alternate standard paragraphs to be consistent with the numbering conventions of NASA Technical Standards.
- Changing the references from NSS/GO-1740.9B to NASA-STD-8719.9 to reflect the release of the new NASA Technical Standard.

The revisions you propose to the existing alternate standard were reviewed. It has been determined that they will not affect the existing alternate standard as they are administrative in nature.

Thank you for your interest in occupational safety and health. If you have any questions, please do not hesitate to contact Thomas K. Marple, Director, Office of Federal Agency Programs, at (202) 693-2122.

Sincerely,

John L. Henshaw

Enclosure

U.S. Department of Labor

Assistant Secretary for
Occupational Safety and Health
Washington, D.C. 20210

JUL 15 1991

Mr. George A. Rodney
Associate Administrator for
Safety and Mission Quality
National Aeronautics and Space
Administration
600 Independence Avenue, S.W.
Washington, D.C. 20546

Dear Mr. Rodney:

The Occupational Safety and Health Administration (OSHA) has completed its review of the proposed alternate standard on suspended loads, as required in 29 CFR 1960.17. With this letter, we want to inform you that we have approved the standard. This approval is based on our determination that the alternate standard provides equivalent protection as would compliance with the following standards in specifically identified operations:

- 1910.179(n)(3)(vi) The employer shall require that the operator avoid carrying loads over people.
- 1910.180(h)(3)(vi) The operator should avoid carrying loads over people.
- 1910.180(h)(4)(ii) No person should be permitted to pass under a load on the hook.

One of the OSHA reviewers stated that this standard, ". . . appears to be a very comprehensive approach to a finite task and requires significant amounts of safety management from the preliminary hazard analysis through completion of the lift." It is essential, however, that management ensure that this level of safety management effort continues to effectively protect the exposed employees.

We appreciate the cooperation provided my staff in the many discussions on this alternate standard. Your interest and support for the safety and health of Federal employees is greatly appreciated.

Sincerely,

Gerard F. Scannell
Assistant Secretary

20 OSHA 1971 1991

A.1 Purpose

A.1.1 This standard applies to specifically identified operations controlled by the National Aeronautics and Space Administration (NASA) involving both civil service and contractor employees. The standard is an alternate to Code of Federal Regulations 29 CFR

1910.179(n)(3)(vi), 29 CFR 1910.180(h)(3)(vi), and 29 CFR 1910.180(h)(4)(ii). NASA Safety is responsible for its implementation and enforcement.

A.1.2 As an alternative standard developed pursuant to Section 1-201(d) of Executive Order 12196 and 29 CFR 1960.17, it applies only to NASA employees. The Occupational Safety and Health Administration (OSHA) will inspect the working conditions of NASA employees performing these specified operations for compliance with these alternate standard requirements. Although OSHA cannot inspect private sector employees working in the same operation with NASA employees for compliance with the alternate standard, it will fully consider the equivalent safeguards specified in this standard for both NASA and contractor employees as the basis for a de minimis violation which is recorded, but not issued.

A.2 Suspended Load Operation Definition.

A.2.1 An operation is considered a suspended load operation and subject to the requirements of this standard if it meets all three of the following criteria:

a. The operation involves the use of a crane, crane structure, or hoist that supports the weight of a suspended load. (This excludes operations where the load is secured in a holding fixture or on substantial blocks supporting the entire load even though the crane/hoist hook may still be attached.) No distinction is made between a static load and a dynamic load. Rigging, i.e., slings, Hydra Sets, lifting fixtures, shackles, straps, when attached to the hook, is considered part of the load.

b. Personnel involved in the operation have any part of the body directly beneath the suspended load. (This excludes operations where employees have their hands on the sides of a load, i.e., to guide the load.)

c. In the event of a crane/hoist failure, as the load drops, it could contact personnel working directly beneath it, with injury or death as a possible result. (This excludes operations where employees have their hands only partially under a load, such that a crane or hoist device failure would push their hands out of the way and not resulting in injury. This also excludes situations where the falling load would come to rest on hardware that is not suspended before an employee could be injured.)

A.3 Requirements.

A.3.1 It is recognized that cranes and hoists do not generally meet the support requirements of a system that would allow personnel to work beneath a suspended load. NASA’s first hazard avoidance protocol is to design hazards out of the system or operation. Accordingly, it is NASA’s intent and goal that all future systems, hardware, and equipment be engineered, designed, installed, and operated to prevent exposing employees to working under loads suspended from cranes and hoists. Due to the uniqueness of NASA activities and the limitations imposed when using present systems, hardware, equipment, and facilities, suspended load operations may be permitted only under specifically approved and controlled conditions. No suspended load operation shall be performed unless all (15) of the following special requirements are met:

A.3.1.1 All suspended load operations will be approved by the Center/facility NASA Director of Safety based upon a detailed engineering hazards analysis of the operation. The hazards analysis will be prepared by the responsible safety organization and coordinated through appropriate engineering and design offices. The analysis documentation will include the following:

a. A justification why the operation cannot be conducted without personnel beneath the load. Feasible procedure/design options will be investigated to determine if the work can be accomplished without personnel working under a load suspended from a crane/hoist.

b. Details of the precautions taken to protect personnel should the load drop. Secondary support systems, i.e., equipment designed to assume support of (catch) the load preventing injury to personnel should the crane/hoist fail, shall be evaluated, and used whenever feasible. Secondary support systems will be constructed with a minimum safety factor of 2 to yield.

c. The maximum number of exposed personnel allowed. Steps shall be taken to limit the number of personnel working under a load suspended from a crane/hoist. Only those essential personnel necessary to perform the operation will be allowed to work in the safety-controlled area.

d. The time of exposure. Steps shall be taken to ensure that personnel do not remain under the load any longer than necessary to complete the work.

A.3.2 Each operation will be reviewed on a case-by-case basis.

A.3.3 Only those suspended load operations approved by the Center/facility NASA Director of Safety will be permitted, subject to this standard. A list of approved suspended load operations will be maintained by NASA Safety and made available to OSHA personnel upon request.

A.3.4 The operational procedures document (e.g., Operations and Maintenance Instruction, Technical Operating Procedure, Work Authorization Document) will be revised to specify the necessary additional requirements identified by the hazard analysis discussed in A.4.1. The procedures will be available on-site for inspection during the operation.

A.3.5 During a suspended load operation, if a new procedure not covered by the original analysis is deemed necessary due to unusual or unforeseen circumstances, the NASA Center/facility Safety Office will be consulted and must approve and document the procedure before operations continue. Safety will coordinate with Operations, Engineering, and other organizations as appropriate. If the new procedure is to be performed on a regular basis, a detailed hazards analysis and approval as outlined in section A.4.1 are required.

A.3.6 The crane/hoist shall be designed, tested, inspected, maintained, and operated in accordance with this standard. Test, inspection, and maintenance procedures will be developed and approved by qualified, responsible NASA engineers. Qualified specialists will perform the procedures and resolve noted discrepancies. NASA Quality Assurance personnel will perform an independent annual inspection of all cranes/hoists involved in suspended load operations. The results of the annual inspections will be maintained and made available to OSHA personnel upon request.

A.3.7 Each crane/hoist involved in suspended load operations shall undergo a Failure Mode and Effects Analysis (FMEA) that shall be approved by the Center/facility NASA Director of Safety. The FMEA will determine the single failure points (SFPs), assessing all NASA Critical mechanical functional components and support systems in the drive trains and NASA Critical electrical components.

A.3.7.1 For those cranes/hoists identified as having no SFP whose failure would result in dropping the load, the total weight of the suspended load shall not exceed the device's rated load.

A.3.7.2 For those cranes/hoists identified as having an SFP whose failure would result in dropping the load, use of that device for suspended load operations must be approved by NASA Headquarters. Complete documentation on the suspended load operation, including the hazards analysis outlined in section A.3.2 and the FMEA described above, will be forwarded to NASA Headquarters for evaluation. Approval will be given based upon detailed analysis of the potential hazards and rationale for acceptance. Such cases will never exceed the device's rated load. OSHA shall be notified when NASA Headquarters approves the use of any crane/hoist identified as having a SFP whose failure would result in dropping the load.

A.3.8 Before lifting the load involved in a suspended load operation, the crane/hoist will undergo a visual inspection (without major disassembly) of components instrumental in assuring that the load will not be dropped (e.g., primary, and secondary brake systems, hydraulics, mechanical linkages, and wire rope per this standard). Noted discrepancies will be resolved before the operation continues. This pre-lift inspection will be in addition to the inspections required in 1910.179(j) and 180(d).

A.3.9 A trained and licensed operator (certified per this standard) shall remain at the crane/hoist controls while personnel are under the load.

A.3.10 Safety controlled areas shall be established with appropriate barriers (rope, cones, etc.). All nonessential personnel shall be required to remain behind the barriers.

A.3.11 Prior to the suspended load operation, a meeting with the crane/hoist operator(s), signal person(s), person(s) who will work under the load, and the person responsible for the task shall be held to plan and review the approved operational procedures that will be followed, including procedures for entering and leaving the safety-controlled area.

A.3.12 Communications (voice, radio, hard wired, or visual) between the operator(s), signal person(s), and the person(s) working under the load shall be maintained. Upon communication loss, operations shall stop immediately, personnel shall clear the hazardous area, and the load shall be secured in a safe position. Operations shall not continue until communications are restored.

A.3.13 Personnel working beneath the load shall remain in continuous sight of the operator(s) and/or the signal person(s).

A.3.14 NASA shall conduct periodic reviews to ensure the continued safety of suspended load operation procedures. As a minimum, NASA will annually evaluate the implementation of these procedures at each Center with operations on the suspended load list.

A.3.15 A list of approved suspended load operations, list of cranes/hoists used for suspended load operations, and copies of the associated hazard analyses will be provided to the OSHA Office of Federal Agency Programs via NASA Headquarters for distribution to the appropriate regional and area OSHA offices. (NASA Headquarters, in conjunction with OSHA, will develop a format for transmittal of this information.) Annual updates to the documentation will be provided as needed.

APPENDIX B. LDE Recommendations for Loaned Equipment and Out-Granting Agreements

B.1 Purpose

B.1.1 The following provides guidance for centers that have leased areas or have loaned equipment to other entities outside of NASA. It helps ensure LDE is returned to its original condition.

Note: See your centers Legal office, reference NPR 8800.15, Real Estate Management Program, NPR 8715.1, NPD 4200.1, Equipment Management Program, and form NF893, Loan of NASA Equipment.

B.1.1.2 Among all the following scenarios:

a. LDEMs should be notified and given the opportunity to provide feedback on the governing document (contract, Space Act Agreement, etc.) when LDE is involved.

b. LDEMs should be notified prior to any LDE modifications.

c. The lessee is responsible for coordinating any suspended load operations directly with OSHA. The NASA Alternate Standard for Suspended Load Operations is not applicable to lessee lifting operations.

B.1.2 These examples are some of the current types of loaned equipment and out-granting scenarios that may occur:

B.1.2.1 LDE Equipment Loan

a. Leased or loaned out NASA LDE equipment to third party entity.

(1) Ensure LDE equipment is denoted in governing document (contract, Space Act Agreement, etc.) as government furnished equipment.

(2) Complete form NF893 Loan of NASA Equipment.

(3) Address how to turn over the equipment. Track equipment conditions upon checkout and after the equipment is returned by completing a periodic inspection that denotes any deficiencies. Address who is responsible for maintenance, repairs, and damage.

(4) Verify operator certification and ensure NASA provides equipment familiarization briefing.

B.1.2.2 Facilities with LDE

a. Out-Grants of NASA Real Property

(1) All entities (including non-NASA) must abide by Federal law for safe workplace operations at Centers. This can be implemented to allow commercial entities the opportunity to conduct work in adherence to essential Federal law and their own organization's safety programs. NASA safety requirements for these zones include a minimum set of policies that ensure hazards are communicated when they impact outside of a partner's property. Third party entity takes responsibility as a lessee.

(2) Lease agreement should contain a checklist of government LDE provided under the lease. At the end of the lease the checklist should be revalidated, identifying the equipment and its condition at that time.

(3) Lessee is required to notify Center if there is an LDE accident, mishap, and/or close call.

b. Third Party Operations Where NASA Provides LDE Support Services

(1) A third-party entity utilizes the facility or portion of facility and NASA conducts the operation in accordance with NASA standards, Center requirements, and in accordance with a Space Act Agreement.

c. Hybrid Scenario

(1) Example 1 – NASA Facility provides equipment and operator; third party provides its own LDE (e.g., rigging or special attachments) for its payload.

(2) Example 2 – NASA provides LDE and there is a mix of NASA and third party entity operators where there is a need to validate/verify/inspect equipment, validate operator certification, provide equipment familiarization briefing, and validate/verify/inspect the equipment after operation to ensure it remains in the same/current state.

(a) Governing document (contract, Space Act Agreement, etc.) should define lift roles/responsibilities and liability.

Note: There should be a center process for verifying third party entities' operator certifications and conducting the LDE equipment familiarization briefing before lifting operations commence.

(b) Identify that the third party is required to meet at minimum 29 CFR 1910 or 29 CFR 1926, its own safety program, and LDE manufacturers' recommendations.

Note: Best practice would be to include applicable VCS.

(c) If LDE equipment is NASA provided, set up a checklist of government equipment provided and then follow the LDE Equipment Loan scenario.

B.1.3 The following list of non-comprehensive questions is provided to generate thoughts and discussion around the logistics for lease agreements between NASA and outside organizations.

Although this list was generated with LDEM in mind, the questions and topics raised can and do apply to other Institutional Safety programs.

B.1.3.1 Footprint

a. Is the building or space shared with NASA personnel and/or other organizations/tenants?

(1) What are the hazard levels/occupancies of the shared building (e.g., is the lessee adjacent to an area with more stringent hazard mitigation requirements, such as Class I, Div. II for a hangar)?

b. Is the entry/egress area(s) shared with NASA personnel and/or other organizations/tenants?

c. Are there any established easements/common areas that would be affected?

B.1.3.2 Facility Infrastructure

a. Do the boundaries of the leased area share any infrastructure with adjacent areas, including but not limited to?

(1) Walls

(2) Utilities (e.g., electrical, potable water, wastewater, fire alarm & suppression, etc.)

(3) Equipment (e.g., overhead cranes, specialized ventilation, etc.)

b. Will the lessee be modifying the infrastructure of the leased building or area?

c. Does the OHC have any Castellated Beam Systems?

(1) What is the plan on communicating hazards, LOTO, inspection, replacement, demolition?

B.1.3.3 Containment

a. Will operations extend beyond the boundaries of the leased area?

b. Do operations have the potential to negatively affect areas adjacent to the leased area (e.g., airborne contamination, groundwater contamination, concussive forces, etc.) as a result of an incident, mishap, or spill?

B.1.3.4 Maintenance

a. Who will be responsible for building infrastructure maintenance (e.g., roofing, foundation, electrical, fire alarm & suppression, potable water, HVAC, installed overhead cranes, etc.)?

(1) This includes but is not limited to interior and exterior aspects of the building infrastructure, as well as above and below ground infrastructure.

B.1.3.5 Operations

a. Who is responsible for ensuring operators/technicians are properly trained and certified?

(1) To what standards will these trainings and certifications adhere?

b. Will the lessee have to develop their own emergency action plan, or will they be required to adhere to the NASA Center's emergency action plan?

(1) If they develop their own, will NASA need to approve it?

(2) Who would be the signatory authority from NASA?

c. Would there be certain types of operations (e.g., lifts involving volatile or hazardous materials) that would need to be reviewed and approved by a NASA authority?

(1) If not, would there be a requirement for the lessee to notify NASA when these types of operations were occurring?

d. Is the lessee required to comply with Agency/Center standards?

(1) If so, which standards/policies would they need to adhere to?

(2) If lessee is required to comply with Agency/Center standards, who is responsible for verifying compliance?

e. What inspection/oversight authority would NASA have over operations, if any?

B.1.3.6 Organizational

a. When operational, footprint, infrastructure, or other requirements are implemented, how are requirements shared with, or designated to, the lessee?

b. In a shared facility, how are requirements shared with, or designated to, the lessees?

c. Who holds the OSHA reporting responsibilities if an event occurs within the leased building?

d. Who holds the OSHA reporting responsibilities if an event occurs within a leased area shared with another tenant?

APPENDIX C. Overhead Crane (OHC) Castellated Beam Systems Memo

Figure 1-B Overhead Crane (OHC) Castellated Beam Systems Memo

National Aeronautics and
Space Administration

Mary W. Jackson NASA Headquarters
Washington, DC 20546-0001

Jun 22, 2021

Reply to Attn of: Office of Safety and Mission Assurance

To: Safety and Mission Assurance (SMA) Directors

From: Chief, Office of Safety and Mission Assurance

Subject: Overhead Crane (OHC) Castellated Beam Systems (CBS)

Safe and successful use of OHC and crane systems are critical to the NASA mission. This memo serves to inform and provide guidance to NASA Centers/Facilities and Programs that utilize OHC CBS in operations. Safety concerns exist with the potential of catastrophic failure of CBS due to fatigue failures in welds. Recent OSMA studies and examination of a moderately used CBS at Marshall Space Flight Center/Michoud Assembly Facility (MSFC/ MAF) confirmed the existence of failed welds within the examined MAF CBS.

Castellated beams, zipper track, serrated track, window track or arch beams were a popular style of support beam used for a crane's runway track and bridge. The definition of a castellated beam is a beam that consists of an inverted "T" shaped section welded to a separate "T" shaped top section, which then creates multiple "arches" or "windows" throughout the length of the beam. The lower section of the beam consists of a hardened metal flange designed for under-hung running cranes.

From the late 1960's, OHC beam manufacturers ceased production of CBS for their runway and bridge beams in the United States. At that time, CBS were perfectly safe and acceptable, but as they age, the metal begins to weaken and fatigue from the stresses of use. As the metal fatigues, the welds begin to weaken where the window portion of the beam attaches to the lower track. If even one weld weakens to the point of where it gives way, the top beam has been documented to peel away from the bottom of the beam—creating a "zipper effect" that occurs all the way down the length of the bridge or runway without warning.

CBS safety concerns by the mid 1970's led CBS manufacturers and the American Institute of Steel Construction (AISC) to issue warnings and cautions prohibiting repairs or modifications of CBS, both welded and stamped construction. Continued use of CBS required the establishment of a comprehensive beam weld inspection and monitoring program. Most manufacturers of CBS recommended a full replacement of the track with a newer type of track system that is equivalent in design and capacity. The manufacturers will not sell repair parts, service these castellated beam systems, or make any recommendations on ways to reinforce or extend the life of these systems.

The major concerns within NASA facilities still operating CBS are as follows:

- Lack of documented Center CBS weld inspection and monitoring programs
- Excessive inactive CBS capacity
- Agency CBS have reached and exceeded service life

We have identified CBS in support of NASA operations at the following locations:

- AFRC
- ARC
- GSFC
- JPL
- LaRC
- MSFC
- MSFC/MAF

Since the probability of fatigue failure in CBS is related to the number of stress cycles encountered during its lifetime of operations OSMA has developed a path forward based on derating safe working load (SWL) until an inspection of welds can be completed, decommissioning CBS not in use anymore, and implementing a long-term inspection and monitoring process for CBS not decommissioned.

The OSMA Lifting Devices and Equipment (LDE) Program Executive and LDE Discipline Lead will work with Center SMA Management and LDE Managers to ensure centers implement the following.

- Immediate de-rating of all active castellated beam systems used in crane operations to 50% SWL until preliminary visual inspection of all welds have occurred by a qualified individual.
  - After preliminary visual inspection has occurred and all welds have been classified as acceptable the CBS can return to 100% SWL
- Catalog and document all CBS (active, idle, and decommissioned). Documentation shall include manufacturer data and installation year, SWL at design, length of castellated beam rail, preliminary inspection results if completed, ROM estimate for replacement by the end of CY21.
- Assess CBS need and future mission
  - Decommission and remove from service excess CBS capacity (tag- out with accident prevention tags, as required by 29 CFR 1910.145(f))
- Initiate a preliminary visual inspection of mission required CBS for continued use. Inspections to be complete by end of CY21.
  - Most CBS weld systems are painted. Assumption, through weld cracks will be visible through paint systems when examined under magnification
  - CBS paint systems should not be disturbed. Because of system age, it is reasonable to assume the existence of lead within some paint systems
  - Remove from service any CBS if deficiencies are discovered through a documented (tag- out with accident prevention tags, as required by 29 CFR 1910.145(f))
- Centers establish, implement, and document a robust inspection and monitoring plan for all castellated beam systems remaining in operation. Inspection plan must include a visual inspection of all welds to occur at a minimum of once a year, and a documented (tag- out with accident prevention tags, as required by 29 CFR 1910.145(f))

- Centers establish, implement, and document a robust inspection and monitoring plan for all castellated beam systems remaining in operation. Inspection plan must include a visual inspection of all welds to occur at a minimum of once a year, and a detail non-destructive evaluation T (NDE/T) inspection (Magnetic particle, dye penetrate, phased array ultrasound (PAUT), etc) of all welds to occur at a minimum of once every four years.
- Recommend centers to develop a long-term strategy for phased replacement of active CBS based on risk to personal and mission.

Should there be any questions, please feel free to contact Clifton Arnold (OSMA LDE Program Executive) at (202)228-0688 or Andy Norris (OSMA LDE Discipline Lead) at (256)544-2755.

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W. Russ Deloach
Chief, Safety & Mission Assurance

APPENDIX D. Summary of Load Test and Inspection Requirements

This table is reference only, see the specific sections in this standard and the appropriate OSHA/VCS reference for all requirements. All LDE testing and inspection must follow manufacturers recommendations.

Table 2 Summary of Load Test and Inspection Requirements

LDE Item	Load Test Factors			Load Test Frequency		Inspection Frequency**		OSHA/ VCS
	Initial Proof *	Periodic		Critical	Non-Critical	Periodic	Frequent	
		Critical	Non-Critical					
Overhead Cranes	1.25	1.0	1.0	1-year	4-year	1-year	Monthly & Pre-Operational	OSHA 1910.179 ASME 30.2 CMAA 78
Hoists and Winches	1.25	1.0	1.0	1-year	4-year	1-year	Monthly & Pre-Operational	ASME B30.16 ASME B30.7 ASME B30.21
PASE* **	1.50	1.0	1.0	1-year	4-year	1-year	Pre-Operational	ASME PASE
Mobile Cranes	1.0	1.0	1.0	1-year	4-year	1-year	Monthly & Pre-Operational	OSHA 1926.1400 ASME B30.5
Slings	2.0	1.0	1.0	1-year		1-year	Pre-Use	OSHA 1910.184 ASME B30.9
Rigging Hardware	2.0	1.0	1.0	1-year		1-year	Pre-Use	ASME B30.26
BTH Lifting Devices	See note below*	1.0	1.0	1-year		1-year	Pre-Use	ASME B30.20/BTH-1
Jacks	1.0	1.0	1.0	1-year		1-year	Pre-Use	ASME B30.1
MEWP	1.0	1.0	1.0	1-year	1-year	1-year	Quarterly & Pre-Operational	ANSI A92
PIT	1.0	1.0	1.0	1-year		1-year	Pre-Operational	OSHA 1910.178 ANSI B56

*Proof load test shall comply with manufacturers and/or designers requirements.

**Pre-use and pre-operational inspections shall be performed by certified LDE operators. Periodic and monthly inspections shall be performed by designated and qualified personnel.

*** Requirements for PASE only apply to NASA Critical lifts and NASA Technical lifts. See section 7 for more details.